This Day is Published, Price 5s. Bound,

A NEW ARITHMETICAL DICTIONARY, OR THE ACCOMPTANT's COMPLEAT ASSISTANT;

WHEREIN

Not only the Terms made Use of in that ART are carefully collected and fully explained,

BUT ALSO

The ART itself is largely treated of;

WITH

GENERAL RULES for its APPLICATION to BUSINESS.

The WHOLE being a COMPLEAT SYSTEM of INTEGRAL and FRACTIONAL ARITHMETIC; Chiefly designed for the Use of SCHOOLS.

To which is prefixed the AUTHOR's PLAN of TEACHING ARITHMETIC.

By JOHN DUNCOMBE,

Inventor of the DENDROMETER, and Mathematical MASTER at Mr. *Crawford's* Academy at *Chiswick.*

LONDON:

Printed for the AUTHOR, and Sold by MONTAGU LAWRENCE, opposite *Bedford-Street, Strand*; and PHILIP ORIEL, Nº 167, *Aldersgate-Street.*

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ADVERTISEMENT.

THE AUTHOR flatters himſelf, That this Work will be a very great Aſſiſtant to Teachers of Arithmetic, as well as a ready Inſtructor to their Pupils; no one Rule or Term of Art on the Subject being omitted, but the Whole treated of in a conciſe tho' univerſal Manner, with a Method of Adding, Subtracting, Multiplying and dividing, by affirmative and negative Numbers, without the Knowledge of Algebra.

That it will be exceeding uſeful to young Perſons entering upon Buſineſs; every Rule being exemplified by Caſes in Exchange, and in foreign as well as domeſtic Trade.

He further preſumes, That it will be of great Service to Gentlemen, as it contains eaſy and accurate Rules for computing Simple and Compound Intereſt, Eſtimating Arrears, Purchaſing of Eſtates in Fee-ſimple and Copyhold; Granting of Annuities and Leaſes for a Time certain or upon the Contingency of ſingle, joint, ſucceſſive and reverſionary Lives; of Fines paid for Renewals, and Premiums given at the firſt entering into Poſſeſſion.

He alſo adds, That it will be highly ſerviceable to every one who wiſhes to attain to any Degree of Proficiency in the moſt deſirable Knowledge of that uſeful and advantageous Science, ARITHMETIC.

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DEDICATION.

To His Royal Highness

The *PRINCE* of

WALES.

May it Please your Royal Highness,

AT a Time when Trade and Commerce, as well as every other Art and Science are flourishing under a wise and good King, permit me, most illustrious Prince, with the most profound Respect and Submission, to put into your Hands a complete SYSTEM of ARITHMETIC.

Were I on this Occasion to follow the common Mode of Dedications, and Attempt to draw the Character of your Royal Highness, I should only be throwing a Veil over those shining Talents with which the Great Author of the Universe hath been pleased to endow you. I will only add,

That

DEDICATION.

That your Highneſs may ever perſevere in the Virtues of your Royal Parents who are the great Supporters of our Church and State, the Guardians of our Liberties, and Encouragers of every uſeful Art and Science, is the fervent Wiſh of him, who has no greater Ambition than to be

Your Royal Highneſs's

Moſt Obedient and Devoted Servant,

JOHN DUNCOMBE.

PREFACE.

AS Arithmetic has been already treated of by many learned and ingenious Gentlemen, it may perhaps be looked upon by some as quite unnecessary to offer any Thing more upon the same Subject; for which Reason I think it is proper to acquaint the Public, that I have not commented upon the Labours of another, that my Plan is entirely new, and that the Explanation of the technical Terms (used in Arithmetic) adds to the Novelty of the Work.

Arithmetic being immediately essential, particularly in commercial and trading Countries, I have therefore endeavoured to treat of it with that Attention which is due to its Utility and Importance.

I have not designedly omitted one single Rule or Term of Art that may be applied with Propriety to the Subject of the following Pages: If any such should have escaped my Attention, a generous Communication thereof will be gratefully acknowledged.

I have illustrated every particular Case with proper Examples, and also prefixed my Plan of teaching Arithmetic, not that I mean to dictate Rules to those Gentlemen who are employed in the important Trust of Educating, but that those who wish to improve by their own Application, may have a regular Method to proceed by.

At the End of the Work I have likewise given a large

a large Collection of useful and entertaining Questions, with their Answers annexed in all the various Rules of Arithmetic, which Questions are intended to assist the Master as well as exercise the Pupil.

Should this Work merit Approbation, and prove serviceable according to my Wishes, I shall think myself amply rewarded for my Labour, as nothing can give me greater, or more sincere Pleasure, than to be found useful in my Station, and a Contributor to public Benefit.

A PLAN

For Teaching

ARITHMETIC.

THE Reason for publishing my Plan of teaching Arithmetic being already mentioned in the Preface, I shall proceed to the Subject without troubling the Reader with any further Apology.

I first proceed to explain the Nature of an Unit, so as to raise a just Conception thereof in the Mind of my Pupil; and from thence convey his Idea to Number. I then proceed to Notation and Numeration; from which I never divert his Attention by the Interposition of any other Process until he is able to write and read any proposed Number with Ease and Certainty.

The next Thing I teach is Addition, Subtraction, Multiplication and Division of Integers: In these also I am very particular, and not only require my Pupil to be expert in the practical Operation, but to understand thoroughly the Reason of every particular Process before he Attempts any Thing further.

N. B. In Division I first make the Divisor an aliquot Part of the Dividend; and after my

Pupil

Pupil is become a Proficient in the Art of dividing, I then make the Divisor an aliquant Part of the Dividend, and thereby shew the Rise and Nature of Vulgar Fractions; of which I next teach the necessary Parts of Reduction.

I then proceed to give my Pupil a true Idea of Proportion, and equality, and from thence lead him to Addition, Subtraction, Multiplication and Division of Money, Weight and Measure, and also of Vulgar Fractions; then Reduction, and Proportion in general, and likewise the Extraction of Roots. All other Rules being only Appendages to those already mentioned, may be taught in any Order as the Fancy directs.

By this Method the Pupil advances through a Series of Consequences which I have always found to be productive of good Effects, even in those of a very confined Genius.

A

A NEW ARITHMETICAL DICTIONARY, OR THE ACCOMPTANT's COMPLEAT ASSISTANT.

A

ABACISTA, an Arithmetician

ABACUS, according to *Pythagoras*, is the common Multiplication-Table diſpoſed in a Square.

ABBREVIATION, is the cutting off, making ſhorter, reducing to fewer or lower Terms.

ABSOLUTE NUMBERS, are ſuch as are expreſſed by Figures only, real, not imaginary.

ABSTRACT NUMBERS, are ſuch as are conſidered as pure Numbers only, without being applied to any Subject whatever.

ABUNDANT NUMBERS, are ſuch that the Sums of their aliquot Parts are greater than the Numbers themſelves.

ACCOMPTS, Eſtimation, reckoning by Numbers.

ACCOMPTANT, one ſkilled in Accompts, an Arithmetician.

ADDITION, is the uniting of ſeveral Numbers, Sums, or Quantities, either Whole or Fractional, ſo as their Value may be expreſſed in one Total.

ADDITION of DECIMALS, is the ſame as that of Integers; due Regard being firſt had in placing the ſeveral Figures according to their reſpective Values; that is, Tenths under Tenths, Hundredths under Hundredths, &c. obſerving alſo to Point off as many Places towards the right Hand of the Total as are contained in the longeſt Decimal given.

N. B. The above Rule holds good when the Numbers are mixed the ſame as though they were pure Decimals only.

EXAMPLE.

Tenths	Hundredths	Thouſandths	Tens ditto
,0	0	6	9
,0	7	6	4
,0	6	4	9
,2	7	0	4
,0	2	8	5
,0	0	7	6
,0	2	9	1
,1	7	6	4
,6	6	0	2

Tenths	Hundredths	Thouſandths	Tens ditto
,4	6	2	–
,0	0	4	3
,0	0	0	8
,2	4	6	–
,7	2	–	–
,4	–	–	–
,2	7	0	9
,3	0	6	–
2,4	1	–	–

Hundreds	Tens	Units	Tenths	Hundredths	Thouſandths	Tens ditto
6	4	6,	2	7	6	4
	3	7,	–	–	–	–
	–	4,	5	–	–	–
	7	6,	4	7	–	–
2	0	0,	0	0	5	9
	1	0,	0	2	–	–
		8,	0	0	1	–
		,	6	7	0	4
9	8	2,	9	4	3	7

ADDITION of INTEGERS, is the uniting of ſeveral abſolute Numbers which are of one and

one and the ſame Denomination; for the Performance of which take this general Rule.

Place the ſeveral Numbers one under another, in ſuch a Manner that Units may ſtand under Units, Ten under Tens, &c. draw a Line under the ſame: Then begin at the Column of Units and add them together, and let the Figure poſſeſſing the Unit's Place of their Sum be ſet under it's reſpective Denomination below the Line drawn, and the remaining Figure or Figures (if any) be carried to, and added with the next ſucceeding Column; proceed with the Sum hence ariſing in the ſame Manner as you did with the former, and continue the Proceſs to the laſt Column, which being added together, its whole Sum muſt be ſet down under the Line, and the Work is finiſhed.

N. B. The Reaſon of this Rule is evident from the Principles of Notation and Numeration.

⁂ If the Numbers to be added are affected with Signs, and they all Affirmative, or all Negative, proceed as before directed, and prefix the Sign, common to all the Numbers, to the Total. But if the Numbers to be added are ſome Affirmative and ſome Negative, collect all thoſe which are Affirmative into one Sum, and all thoſe which are Negative into another Sum; ſubtract the leſſer Sum from the greater: Their Difference will be the Total; to which prefix the ſame Sign as that of the greateſt Sum.

The like is to be obſerved in every Kind of Addition.

EXAMPLES

2642	−3604	−8321
1476	−7029	−1627
3459	− 463	+ 540
6720	−9046	− 26
4067	− 72	+4627
2953	−3560	
3648	− 100	−9974
1046	−6047	+5167
26011	−29921	−4807

N. B. Every Number not having a Sign prefixed to it, is always underſtood to be Affirmative.

There are ſeveral Methods of proving Addition Sums; but that which is moſt practiſed is as follows.

Repeat the former Operation, omitting at the ſame Time, the uppermoſt Number, and to the Total ſo found add the Number before omitted; the firſt and laſt Total will be alike if the Work is juſt. This is founded on the following well known Axiom: *The Sum of all the Parts, howſoever taken, is equal to the Whole.*

ADDITION of MONEY, WEIGHT, and MEASURE, is the uniting of ſeveral Sums, or Quantities, which are of more Denominations than one; but all ſubject to the ſame principal

principal Integer. The general Rule for its Practice is as follows.

Place the Particulars of each Denomination in one Sum or Quantity, exactly under the Particulars of the same Denomination in another Sum or Quantity; that is, Pence under Pence, Shillings under Shillings, Hundreds under Hundreds, &c. draw a Line under the same, then (beginning at the right Hand) add the Particulars of the least Denomination together, and divide the Sum by as many Units of its own Name, as are contained in an Unit of the next succeeding Denomination; and let the Remainder, if any, or otherwise a Cypher be set down under its respective Column below the Line, and the Quotient carried to, and added with the Particulars of the aforesaid next succeeding Denomination: Proceed with the Sum hence arising in the same Manner as you did with the former, and continue the Process to the last or greatest Denomination, which is integral, and must be added as in simple Addtion.

N. B. When the Sum of the Particulars is less then the Number contained in an Unit of the next succeeding Denomination; in such Case set down the said Sum under its respective Column, and proceed with the next Denomination without carrying any Number to it.

EX-

EXAMPLES.

l.	s.	d.	Cwt	Q.	lb
146	12	4	146	1	14¾
276	16	0½	304	0	17
34	0	6	16	2	27½
6	11	2¾	406	3	0
0	4	11	234	0	6¼
102	16	0¼	169	2	11
690	4	3	0	1	0¾
0	0	2½	106	0	2
6	0	0	394	3	16¼
100	17	6¾	132	2	1
1364	3	0¾	1911	1	12½

Sums of this Kind are proved in the ſame Manner as thoſe in Addition of Integers.

ADDITION of VULGAR FRACTIONS admits of two Caſes: *Firſt*, When the Fractions to be added are all ſimple, and of the ſame Denomination. *Secondly*, When they are of ſeveral Kinds, and of more Denomination than one, but all ſubject to the ſame principal Integer. The general Rule is as follows.

In the firſt Caſe, Reduce the Fractions to a common Denominator, and add all the new Numerators together for the Numerator of their Sum, under which put the common Denominator.

In the ſecond Caſe, Reduce all the Fractions to ſimple ones, and thoſe ſimple ones to others, which ſhall have one Denomination common to them all, and proceed therewith

with as in Caſe the *Firſt*. If whole or mixed Numbers occur, reduce them to improper Fractions and proceed as before directed.

Or in either Caſe, Reduce the given Fractions to their equivalent Values, in the known Parts of their reſpective Integers, and proceed as in Addition of whole Numbers.

EXAMPLES.

Add $\frac{3}{4}$, $\frac{7}{8}$, and $\frac{3}{7}$ together.

$3\times8\times7 = 168$ }
$7\times4\times7 = 196$ } New Numerators
$3\times4\times8 = 96$ }

Total 460

$4\times8\times7 = 224$ Com. Denominator

hence $\frac{3}{8}+\frac{7}{8}+\frac{3}{7} = \frac{460}{224} = \frac{115}{56} = 2\frac{3}{56}$ the Sum

---

Add $\frac{7}{8}$ of a £ and $\frac{3}{4}$ of a Penny to 18*s*.

$20\times12\times4 = 960$

hence $\frac{3}{4}d. = \frac{3}{960}$£

and 18*s*. $= \frac{18}{20}$£

then by reducing $\frac{7}{8}$, $\frac{3}{960}$ and $\frac{18}{20}$ to a common Denominator, the Work will ſtand thus

$7\times960\times20 = 134400$ }
$3\times8\times20 = 480$ } New Numerators
$18\times8\times960 = 188240$ }

Total 273120

$8 \times 960 \times 20 = 153600$ Com. Denominator.

hence $\frac{7}{8}$£ + $\frac{3}{4}d$ + 18*s*. $= \frac{273120}{153600}$£ $= \frac{569}{320}$£

$= 1\frac{249}{320}$£ = 1 £ 15 *s.* 6¾ *d.* the Sum.

Proof by the last Rule.

		l.	*s.*	*d.*
⅞ of a Pound Sterling	=	0	17	6
¾ of a Penny ——	=	0	0	0¾
18*s*. — —	=	0	18	0
Total as above		1	15	6¾

AFFIRMATIVE NUMBERS, are ſuch as expreſs ſomething Real, or that which hath Exiſtance.

AGGREGATE, the Sum Total.

AGIO, is the Difference between the Bank and Current Money of any Country, and is (according to the Cuſtom of the Place) from one to ten per Cent. &c. in favour of the Bank.

N. *B.* The Agio is eſtimated according to the Credit of the Bank when compared with that of the Merchants and Traders of the Place.

ALGEBRA, ſpecious Arithmetic.

ALE MEASURE. According to the Standard kept in the Exchequer, the Ale Gallon contains 282 Cubic Inches, and from thence the following Table is computed.

Cub.

Cub. In.	Pints	Qts	Galls	Fir.	Kil.	Barr.	Hds.	But.
$35\frac{1}{4}$	1	—	—	—	—	—	—	—
$70\frac{1}{2}$	2	1	—	—	—	—	—	—
282	8	4	1	—	—	—	—	—
2256	64	32	8	1	—	—	—	—
4512	128	64	16	2	1	—	—	—
9024	256	128	32	4	2	1	—	—
13536	384	192	48	6	3	$1\frac{1}{2}$	1	—
27072	768	384	96	12	6	3	2	1

This Meaſure is uſed by Brewers in gauging their Worts and eſtimating the Capacity of their Veſſels; alſo by this Standard His Majeſty's Officers in the Exciſe compute the Duties on Malt Liquors.

ALGORITHM, the Subſtance of the four primitive Rules, Addition, Subtraction, Multiplication and Diviſion.

ALIQUANT PART, is ſuch as will not divide the Whole without leaving a Remainder.

ALIQUOT PART, is ſuch as will divide the whole without leaving any Remainder.

ALLIGATION, is a Rule which teaches how to mix any Number of Simples of different Qualities together, ſo as their Compoſition may be of a mean Degree of Quality, aſſigned, between the Extreams of thoſe of the given Simples.

ALLIGATION ALTERNATE, is when the Rates of ſeveral Simples being given, it is required to find ſuch Quantities of the ſaid Simples as will make a Compoſition, which ſhall bear a mean Rate propoſed.

And firſt, It is neceſſary that the given Rates, as well as that propoſed, be the re-

ſpective Prices of equal Quantities; and if not, that they be reduced to ſuch. Theſe Things being premiſed, the general Rule is as follows.

Reduce all the Rates to one and the ſame Denomination; place the reduced Rates of the Simples one under another, as in Addition of Integers, and link all of them one with another in ſuch a Manner that the Rates ſo linked may be the one greater and the other leſs than the mean Rate: Place the mean Rate on the left hand Side of the Rates of the Simples. Find the Difference between the mean Rate and the Rate of each Simple ſeverally, and place it on the right hand Side, oppoſite to the Yoke-fellow of that Rate from which the Difference was taken; then will the ſaid Differences expreſs the required Quantities of the ſeveral Simples according to the reſpective Rates to which they ſtand oppoſed.

Theſe Quantities being thus obtained, many others (in Proportion) may be found which will anſwer the ſame Conditions.

N. B. If any one of the Rates be linked to two or more of the reſt, it will have as many Differences placed oppoſite to it, as it has Yoke-fellows; and each of its Yoke-fellows will have the common Difference between it and the mean Rate placed againſt it.——When two or more Differences ſtand againſt one Rate, ſuch Differences muſt be added together and their Sum ſubſtituted inſtead of the Differences themſelves.

EX-

EXAMPLES.

A Grocer propoſes to mix together four Sorts of Sugar, *viz.* one at 54*s.* per Cwt. d° at 46*s.* ditto at 40*s.* and ditto at 30*s.* it is required to find a Quantity of each that will make the ſaid mixture worth 45*s.* per Cwt.

	s.		Cwt	
45	54	— —	5	Anſwer
	46	— —	15	
	40	— —	9	
	30	— —	1	

	s.		Cwt	
45	54	— —	15	Anſwer
	46	— —	5	
	40	— —	1	
	30	— —	9	

	s.		Cwt	
45	54	— — —	15	Anſwer
	46	5 + 15 =	20	
	40	— — —	1	
	30	9 + 1 =	10	

	s.		Cwt	
45	54	5 + 15 =	20	Anſwer
	46	— — —	5	
	40	9 + 1 =	10	
	30	— — —	9	

	s.		Cwt	
45	54	5 + 15 =	20	Anſwer
	46	— — —	15	
	40	— — —	9	
	30	9 + 1 =	10	

N. B.

N. B. These several Answers arise from the different Ways of linking the given Rates.

A Vintner would mix together three Sorts of Wine, *viz.* One at 18*s.* per Gallon, ditto at 14*s.* 6*d.* and ditto at 12*s.* 9*d.* the Quantity of each is required that will make the said mixture worth 4*s.* per Bottle.

4*s.* per Bottle = 16*s.* per Gallon.

	s. *d.* *d.*		Galls.
s. *d.*	18 0 = 216	18 + 39 = 57	
16 = 192	14 6 = 174	- - 24	Answer
	12 9 = 153	- - 24	

ALLIGATION MEDIAL, is when the Quantities of the several Simples contained in a Composition being given separately, together with the Rate or Value of each Quantity, it is required to find the mean Rate or Value of any proposed Part of the said Composition. The Rule is as follows.

Find the Values of the several Simples according to their respective Rates and Quantities, and divide the Sum total of the said Values by the Sum total of the Quantities of the Simples, the Quotient will be the mean Rate.

Or by Proportion, as the Sum total of the Quantities of the Simples is to the Sum total of their Values, so is any Part of the Composition to its equivalent Value. This Rule serves to prove Alligation Alternate.

EXAMPLE.

A Vintner mixed 57 Gallons of Wine at 18*s.* per Gallon, with 24 ditto at 14*s.* 6*d.* and

and 24 ditto at 12*s.* 9*d.* The Rate per Bottle of the said Mixture is required.

Galls.		*s.*	*d.*		*l.*	*s.*
57	at	18	0	=	51	6
24	at	14	6	=	17	8
24	at	12	9	=	15	6
Total 105					Total 84	0

Galls. Qts.
105 = 420

Qts. £ Qt.
As 420 : 84 :: 1
20

420)1680(4*s.* Answer
1680

ALLIGATION PARTIAL, is when the mean Rate of a Composition and the Rates of the several Simples contained in that Composition being given, together with the Quantity of any one of the Simples, it is required to find the corresponding Quantities of the other Simples.

RULE.

Find the several Differences between the mean Rate and the Rates of the Simples as in Alligation Alternate, and then (by Proportion) as the Difference opposite the Rate of that Simple whose Quantity is given is to the Rest of the Differences severally; so is the given Quantity of the Simple to the corresponding Quantities of the other Simples respectively.

EXAMPLE.

A Grocer mixed together three Sorts of Sugar in the following Manner, a certain

certain Quantity at $4\frac{1}{2}d$ per ℔, ditto at 7*d*. and 12℔ at 9*d*. The Mixture was worth 6*d*. per ℔, it is required to find the several Quantities according to their respective Rates.

d. qr.			℔
6 = 24	$4\frac{1}{2}$ = 18		4+12 = 16
	7 = 28		- - - 6
	9 = 36		- - - 6

℔ ℔ ℔	℔ ℔ ℔
As 6 .. 16 :: 12	As 6 .. 6 :: 12
12	12
6) 192	6) 72
32℔	12℔

℔		d.	
32	at	$4\frac{1}{2}$	Answer
12	at	7	
12	at	9	

Questions in this Rule are proved by Alligation Medial.

ALLIGATION TOTAL, is when the Rate, and Quantity of a Composition, and also the Rates of the several Simples contained in that Composition being given, it is requir'd to find the distinct Quantities of the said Simples.

R U L E.

Find the several Differences between the mean Rate and those of the Simples as in Alligation Alternate, and then (by Proportion) as the Sum Total of the Differences is to each of the Differences severally; so is the given Quantity of the Composition to the corresponding Quantities of the Simples respectively.

EX-

EXAMPLE.

A Grocer made a Mixture worth 6*d.* per ℔ of three Sorts of Sugar, *viz.* one at 9*d.* per ℔ ditto at 7*d.* and ditto at $4\frac{1}{2}$*d.* The total Quantity of the Mixture was $\frac{3}{4}$ of an Cwt. *Query*, The distinct Quantity of each Sort according to its respective Rate.

d.	qr.	d.		qr		℔
6 = 24		9	=	36	– – –	6
		7	=	28	– – –	6
		$4\frac{1}{2}$	=	18	4 + 12 =	16
					Total	28 ℔

℔ ℔ qr.
As 28 .. 16 :: 3
28
84
16
504
84
28) 1344 (48 ℔
112
224
224

℔ ℔ qr.
As 28 .. 6 :: 3
28
84
6
28) 504 (18 ℔
28
224
224

Again as 28 ℔ .. 6 ℔ :: 3 qr. .. 18 ℔

℔		d.	
18	at	9	Answer
18	at	7	
48	at	$4\frac{1}{2}$	

AL-

ALTERNATE PROPORTION, is when of four Terms, the firſt and laſt Antecedent are compared with each other, and the firſt and laſt Conſequent. That is, As the firſt Antecedent is to the laſt Antecedent, ſo is the firſt Conſequent to the laſt Conſequent.

AMIABLE NUMBERS, are ſuch as are mutually Equal to the Sum of each other's Aliquot Parts.

AMOUNT (in Intereſt) is the Sum total of the Principal and the Intereſt due upon that Principal at the End or Expiration of any determinate Space of Time.

ANALOGY, Proportion, the Compariſon of ſeveral Ratios of Numbers, one to another.

ANATOCISM, a Species of Uſury, Compound Intereſt.

ANNUITY, an yearly Revenue or Income to continue during a Perſons Life or ſome certain Terms of Years.

ANNUITIES in ARREAR, when an Annuity payable either yearly, half-yearly or Quarterly, &c. becomes due and is forborn or with-held for one or more Payments, ſuch an Annuity is ſaid to be in Arrear, in the Doctrine of which the following Things are conſidered.

I. The *Annuity*.

II. The *Times* of Forbearance, *viz.* the Number of Payments in Arrear.

III. The *Rate* per Cent. per Annum of Intereſt.

IV. The *Amount* of the Arrears and the Intereſt due thereon taken together. Any three of theſe being known the fourth alſo may

may be known by attending to the following Cases.

CASE I.

The *Annuity*, *Rate* and *Times* being given to find the *Amount*.

RULE. *First at simple Interest.* To the Square of the *Times* multiplied by the *Ratio* add double the *Times*, and from the Sum subtract the Rectangle of the *Times* into the *Ratio*; multiply half the Difference by the *Annuity*; the Product will be the *Amount*.

N. B. If the Payments are half yearly work with half the *Annuity* and half the *Ratio*. If Quarterly, with a Quarter of the *Annuity* and a Quarter of the *Ratio*.

Secondly, At compound Interest. Raise the *Ratio* to a Power whose Index is equal to the given *Times*, and from the Power so raised subtract an Unit, and multiply the Difference by the *Annuity*; reserve the Product. Then from the *Ratio* subtract an Unit, and with the Difference so found divide the Product before reserved: The Quotient will be the *Amount*.

EXAMPLE.

Suppose an annual Rent of 70*l.* be forborn five Years, what does it amount to; Interest being computed at 5*l. per Cent. per Annum*?

I. At simple Interest.

5
5
———
25
,05
———
1,25
10,
———
11,25
,25*
———
2)11,0
———
5,5
70
———
£ 385 Answer

,05
5
———
,25*

1,05
1
———
‡ ,05

By comparing the Work of these Examples it will be easy to Judge of the Cause producing those disagreable Effects arising from a Non-payment of the Interest of Mortgage Money.

II. At compound Interest.

1,05
1,05
———
525
105
———
1,1025
1,1025
———
55125
22050
121275
———
1,21550625
1,05
———
607753125
121550625
———
1,27628156,25
1,
———
,27628156,25
7*
———
‡ ,05)19,339709375
———
386,7941875
£386 : 15 : 10½,42 Ansr

Had the Payments in the foregoing Example been either Half-yearly or Quarterly, the Work would have stood as follows.

I. Half-

I. Half-yearly.
Payments and simple Interest.

```
        10
        10
       ---
       100
      ,025
,025  ----
  10  2,500
----   20,
,250*  ----
====  22,500
       ,250*
      ------
    2)22,250
      ------
      11,125
          35
      ------
       55625
      33375
    --------
   389,375=
 l.  s. d.
389  7  6 Answer
```

II. Quarterly.
Payments and simple Interest.

```
      20
      20
     ---
     400
   ,0125
   -----
  5,0000
     40,      ,0125
   -----         20
   45,00     ------
    ,25*     *,2500
   -----     ======
 2)44,75
   -----
  22,375
    17,5
  ------
  111875
 156625
 22375
 --------
 391,5625=
  l.  s. d.
 391 11  3 Answer
```

By comparing these Examples with the Former as well as with each other, it will be easy to conceive the Advantage accruing to Landlords from half-yearly and quarterly Payments of Rent.

CASE

CASE II.

The *Amount*, *Times* and *Rate* being given, to find the *Annuity*.

RULE. *First*, *At simple Interest*. To the Square of the *Times* multiplied by the *Ratio*, add twice the *Times*, and from the Sum subtract the Rectangle of the *Times* into the *Ratio* and with half the Difference so found divide the *Amount*; the Quotient will be the *Annuity*.

N. *B*. If the Payments are Half-yearly or Quarterly, proceed according to Note of Case the First; then will the Quotient be equal to an half or a quarter of the Annuity respectively.

Secondly, *At compound Interest*. From the *Ratio* subtract an Unit, and with the Difference multiply the *Amount*; reserve the Product; then raise the *Ratio* to a Power whose Index is equal to the given *Times*, and from the Power so raised subtract an Unit, and with the Difference so found divide the Product before reserved, the Quotient will be the *Annuity*.

EXAMPLE.

What Annuity forborn five Years will Amount to 385*l*. at simple Interest, and 386*l*. 15*s*. 10½*d*, at compound Interest, the Rate per *Cent*. being 5*l*. per *Annum*?

I. Simple

I. Simple Intereſt.

```
        5
        5
      ----
       25          ,05
       ,05           5
      ----        ----
      1,25         ,25*
     10,          ====
    ------
     11,25
      ,25*
    ------
   2)11,0
    ------
     5,5 )385,0(70l. Anſwer
          385
         ------
          ...0
         ======
```

II. Compound Intereſt.

```
l.   s.  d.
386  15  10½,42 = 386,7941875
                       ,05
               ----------------
               19,33970947 5*
              =================

1,05+1,05+1,05+1,05+1,05=
1,2773115625
1,
-----------
,2773115625)19,339709375 0*(70l.Ans.
            19 339709375
            ------------
```

CASE

CASE III.

The *Annuity*, *Times* and *Amount* being given, to find the *Rate*.

RULE. *First*, *At Simple Interest*. From double the *Amount* subtract the doubled Rectangle of the *Annuity* into the *Times*, and multiply the Difference by an hundred; reserve the Product. Then from the Square of the *Times* subtract the *Times*, and multiply the Difference by the *Annuity*, and with the Product so found divide the Product before reserved; the Quotient will be the *Rate per Cent. per Annum*.

N. B. The same is here to be understood as in Note of Case the second with respect to the Payments and Quotient.

Secondly, *At Compound Interest*. As this Case requires an algebraic Solution, I shall omit it, as being foreign to the present Design.

EXAMPLE.

At what Rate *per Cent. per Annum* will an Annuity of 70*l.* amount to 385*l.* in five Years, at simple Interest?

5	385	70
5	2	5
25	770	350
5	700*	2
20	70	700*
70	100	
1400	1400)7000(5*l.* Answer.	
	7000	

CASE

CASE IV.

The *Annuity*, *Rate* and *Amount* being given, to find the *Times*.

RULE. *First*, *At Simple Interest.* From the Number *two* subtract the *Ratio*, and divide the Difference by double the *Ratio*; reserve the Quotient; then divide the *Amount* by the Rectangle of the *Annuity* into half the *Ratio*, and to the Quotient so found add the Square of the Quotient reserved: Extract the square Root of the Sum, from which Root subtract the aforesaid Quotient reserved. The Difference will be the *Times*.

N. B. It is necessary that the Nature of the Payments be ascertained, for if they are Half-yearly or Quarterly, you must work with half the *Annuity* and half the *Ratio*, or a quarter of the *Annuity* and a quarter of the *Ratio* respectively.

Secondly, *At Compound Interest.* From the *Ratio* subtract an Unit, and to the Rectangle of the Difference into the *Amount* add the *Annuity*, and divide the Sum by the *Annuity*: The Quotient will be a Power of the *Ratio* whose Index is equal to the *Times*. Therefore divide the said Power and the successive Quotients continually by the *Ratio*, until the last Quotient is an Unit and and the Remainder a Cypher: The Number of those Divisions will be equal to the *Times*.

EX-

EXAMPLE.

In what Time will an Annuity of 70*l.* amount to 385*l.* at simple Interest and 386*l.* 15*s.* 10½*d*, 42 at compound Interest; the Rate *per Cent.* being 5*l. per Annum*, and the Payments yearly?

First, At Simple Interest.

```
       2,00           2),05
       0,05           -----
      -----            ,025
   *,1)1,95              70
      -----           ------
 ,05   19,5§       1,750)385,00(220‡
   2   19,5              350
 ---  -----              ---
*,10   975               350
 ===  1755               350
       195               ---
      -----              ..0
      380,25             ===
    ‡ 220
      ------
      600,25(24,5
      4          19,5§
      ----       -----
   44)200        £5 Answer.
      176
      ------
  485)2425
      2425
      ====
```

Secondly,

Secondly, at Compound Interest.

l. s. d.

386 15 10½,42=386,7941875
,05*

1,05
1,

,05*

19,339709375
70,

7|0)8|19,339709375

1,05)1,27628156 25(1,21550625
105

226
210

162
105

578
525

531
525

656
630

262
210

525
525

Continued in the next Page.

Continued from the foregoing Page.

```
                      1,05       1,05   1,05
1,05(1,21550625(1,157625(1,1025(1,05(1
     1,05          1,05     105    105
     ----          ----     ---    ===
      165           107     525
      105           105     525
      ---           ---     ===
       605           262
       525           210
       ---           ---
        800           525
        735           525
        ---           ===
         656
         630
         ---
          262        Answer, 5 Years = N° of
          210                Divisions.
          ---
           525
           525
           ===
```

ANNUITIES in REVERSION, when an Annuity is not in present Possession, but is to be had or enjoyed after the End or Expiration of some certain Time such an Annuity is said to be in Reversion. *Vide purchasing Annuities in Reversion.*

ANNUMERATION, a reckoning into the Number.

ANTECEDENT, (in Proportionals) is the first Term of Comparison.

ANTI-

ANTILOGARITHM, is the Complement of any Logarithm to its Radius.

ANTINUMBER, is that which ſtands before another.

APHORISM, a general Rule or known Maxim.

APODIXIS, a Proof or Demonſtration.

APOTHECARIES WEIGHT, has the Pound and Ounce the ſame as thoſe of Troy Weight, only differently divided and ſubdivided as in the following Table.

Grs	℈	ʒ	℥	℔
20	1	—	—	—
60	3	1	—	—
480	24	8	1	—
5760	288	96	12	1

By this Weight the Apothecaries compound their Medicines, but they buy and ſell their Drugs by Avoirdupoiſe Weight.

APPROXIMATION, is a continual Approach to the Root or Number ſought without ever expecting to obtain it exactly.

ARITHMANCY, a kind of Divination by Numbers.

ARITHMETIC, is the Art or Science of computing by Numbers, either whole or Fractional, and is conſidered both in Theory and Practice.

ARITHMETIC of SURDS is the Doctrine of irrational Numbers.

ARITHMETIC of INFINITES, is the Art of ſumming up, or finding the Ratios, of a Series of Numbers whoſe Terms are Infinite.

ARITHMETICAL, of or belonging to Arithmetic.

ARITHMETICAL COMPLEMENT of a Logarithm, is what it wants of 10,000000.

ARITHMETICAL MEAN, between any two Numbers, is half their Sum.

ARITHMETICAL PROGRESSION, is when in a Series of Terms the Numbers Increase or Decrease by equal Differences.

The Doctrine of Arithmetical Progressionals admits of twenty Cases, which are as follows.

CASE I.

The Extreams, and Number of Terms being given, to find the Sum of all the Terms.

RULE. Multiply the Sum of the Extreams by the Number of Terms, and divide the Product by two; the Quotient will be equal to the Sum of all the Terms.

EXAMPLE.

There are 7 Terms in Arithmetical Progression, the least Extream is 6 and the greatest 30. *Query*, The Sum of all the Terms.

30		6 — —	1
6		10 — —	2
——		14 — —	3
36		18 — —	4
7		22 — —	5
——		26 — —	6
2)252		30 — —	7
——		——	
126	Answer	126	Proof

CASE II.

The greatest Extream, Number of Terms, and their common Difference being given, to find the Sum of all the Terms.

RULE. To the doubled Rectangle of the greatest Extream into the Number of Terms, add the Rectangle of the common Difference into the Number of Terms, and from the Sum subtract the Rectangle of the common Difference into the Square of the Number of Terms; divide the Difference so found by two; the Quotient will be equal to the Sum of all the Terms.

EXAMPLE.

There are 7 Terms in Arithmetical Progression, the greatest Extream is 30 and the common Difference four. *Query*, The Sum of all the Terms.

```
  30          7          7
   7          4          7
 ---        ---        ---
 210         28*        49
   2        ===          4
 ---                   ---
 420                   196‡
  28*                  ===
 ---
 448
 196‡
 ---
2)252
 ---
 126 Answer
```

CASE

CASE III.

The least Extream, Number of Terms and their common Difference being given, to find the Sum of all the Terms.

Rule. To the Rectangle of the least Extream into the Number of Terms add half the Rectangle of the common Difference into the Square of the Number of Terms, and from the Sum subtract half the Rectangle of the Number of Terms into the common Difference; the Difference so found will be equal to the Sum of all the Terms.

EXAMPLE.

There are 7 Terms in arithmetical Progression; the least Extream is 6, and the common Difference 4: *Query*, The Sum of all the Terms.

7	7	7
6	7	4
42*	49	2)28
98	4	14‡
140	2)196	
14‡	98*	
126 Answer		

CASE IV.

The Extreams, and common Difference of the Terms being given, to find the Sum of all the Terms.

Rule.

Rule. To the Rectangle of the common Difference into the Sum of the Extreams, add the Square of the greater Extream, and from the Sum subtract the Square of the lesser Extream, divide the Difference so found by double the common Difference of the Terms: The Quotient will be equal to the Sum of all the Terms.

EXAMPLE.

There are a certain Number of Terms in arithmetical Progression whose common Difference is 4, the least Extream is 6, and the greatest 30: *Query*. The Sum of all the Terms.

30	30	6
6	30	6
36	900*	36‡
4		
144		
900*		
1044	4	
36‡	2	
§8)1008	8§	
126 Answer		

CASE V.

The Extreams, and Number of Terms being given, to find their common Difference.

Rule.

Rule. From the Number of Terms subtract an Unit, and with the Difference so found divide the Difference of the Extreams: The Quotient will be equal to the common Difference of all the Terms.

EXAMPLE.

There are 7 Terms in arithmetical Progression; the least Extream is 6 and the greatest 30: *Query*, Their common Difference.

```
 7        30
 1         6
---      ----
 6*     *6)24
===      ----
            4 Answer
         ======
```

CASE VI.

The greatest Extream, Number of Terms, and Sum of all the Terms being given, to find the common Difference.

Rule; From the doubled Rectangle of the greatest Extream into the Number of Terms, subtract double the Sum of all the Terms; reserve the Difference: Then from the Square of the Number of Terms subtract the Number of Terms, and with the Difference so found divide the Difference before reserved: The Quotient will be equal to the common Difference of all the Terms.

EX-

EXAMPLE.

There are 7 Terms in arithmetical Progression; the greatest Extream is 30 and the Sum of all the Terms 126: *Query*, Their common Difference.

```
  30          126        7
   7            2        7
 ---          ---       --
 210          252*      49
   2          ===        7
 ---                    --
 420                    42‡
 252*                   ==
 ---
‡42)168(4 Answer
    168
    ===
```

C A S E VII.

The least Extream, Number of Terms, and Sum of all the Terms being given, to find their common Difference.

RULE. From double the Sum of all the Terms subtract the doubled Rectangle of the least Extream into the Number of Terms; reserve the Difference: Then from the Square of the Number of Terms subtract the Number of Terms, and with the Difference so found divide the Difference before reserved: The Quotient will be equal to the common Difference of all the Terms.

EXAMPLE.

There are 7 Terms in arithmetical Progression; the least Extream is 6 and the

Sum of all the Terms 126: *Query*, Their common Difference.

126	6	7
2	7	7
252	42	49
84*	2	7
‡42)168(4 Answer	84*	42‡
168		

C A S E VIII.

The Extreams, and Sum of all the Terms being given, to find their common Difference.

RULE. From the Square of the greatest Extream subtract the Square of the least Extream; reserve the Difference: Then from double the Sum of all the Terms subtract the Sum of the Extreams, and with the Difference so found divide the Difference before reserved: The Quotient will be equal to the common Difference of all the Terms.

EXAMPLE.

There are a certain Number of Terms in arithmetical Progression; the least Extream is 6 and the greatest 30, the Sum of all the Terms is 126, *Query*, Their common Difference.

30	6	126	30
30	6	2	6
900	36*	252	36§
36*		36§	
‡216)864(4 Anſwer		216‡	
864			

CASE IX.

The Extreams, and Sum of all the Terms being given, to find the Number of Terms.

RULE. Divide the doubled Sum of all the Terms by the Sum of the Extreams: The Quotient will be equal to the Number of Terms.

EXAMPLE.

There is a ſeries of arithmetical Progreſſionals whoſe leaſt Extream is 6 and the greateſt 30; the Sum of all the Terms is 126: *Query*, The Number of Terms.

126	30
2	6
*36)252(7 Anſwer	36*
252	

CASE

CASE X.

The Extreams, and common Difference of all the Terms being given, to find the Number of Terms.

Rule. To the Difference of the Extreams add the common Difference of all the Terms, and divide the Sum by the said common Difference: The Quotient will be equal to the Number of Terms.

EXAMPLE.

In a Series of arithmetical Progressionals the least Extream is 6 and the greater 30; the common Difference of the Terms is 4; *Query*, The Number of Terms.

```
  30
   6
  --
  24
   4
  --
4)28(7 Answer
```

CASE XI.

The greatest Extream, common Difference, and Sum of all the Terms being given, to find the Number of Terms.

Rule. To double the greatest Extream add the common Difference, and divide the Sum by double the said common Difference;

ence; reserve the Quotient: Then from the Square of the Quotient reserved, subtract the Quotient arising from dividing the doubled Sum of all the Terms by their common Difference; extract the Square Root of the Difference so found, which Root add to, and Subtract from, the Quotient before reserved: The Sum, or the Difference, will be equal to the Number of Terms: The Particular of which may be found by the following Rule.

First. If either the Sum or the Difference be a mixed Number, or a Fraction, the other will be equal to the Number of Terms.

Secondly. If both the Sum and the Difference are integral, take either of them for the Number of Terms, and therewith find the least Extream, according to Case XIV. Then find the Sum of all the Terms. (per Case I.) If the Sum so found be equal to that which was given, the right Number is already taken: But if they are unequal, the other is the Number required.

N. B. If the least Extream, found as above, be Negative, it is probable the wrong Number is taken, notwithstanding it may answer the Conditions of the Question.

EXAMPLE.

In a Series of arithmetical Progressionals, the greatest Extream is 30, the Sum of all the Terms 126, and their common Difference 4: *Query*, The Number of Terms.

```
  30          126          8§
   2            2          1*
 ---         ----         ---
  60        4)252          9 the Sum
----         ----         ===
8)64          63‡
   8§          ===         8§
   8                       1*
----                      ---
  64                       7 the Difference
  63‡                     ---
----
  1(1*
   1
  ===
```

Here the Sum and Difference being integral, let us suppose 9 to be the Number of Terms, then per Case XIV.

```
  30          9
   4          4
 ---         ---
  34         36‡
  36‡        ===
 ---
 -2 = the least Extream
```

And

And per Case I.

$$
\begin{array}{r}
30 \\
-2 \\
\hline
28 \\
9 \\
\hline
2)252 \\
\hline
126
\end{array}
$$

126 = the Sum of all the Terms as first given.

Altho' this Number answers the Conditions of the Question, yet it is most resonable to conclude that 7 are the Number of Terms required, for then the least Extream would be Affirmative; (*viz* 6) as may be proved at leisure.

CASE XII.

The least Extream, Sum of all the Terms and their common Difference being given, to find the Number of Terms.

This Case admits of three Varieties.

1. *When the common Difference is equal to double the least Extream.*
2. *When the common Difference is less than double the least Extream.*
3. *When the common Difference exceeds double the least Extream.*

RULE

Rule. (*Variety* 1.) Divide the doubled Sum of all their Terms by the common Difference, and Extract the Square Root of the Quotient: The Root so found will be equal to the Number of Terms.

(*Variety* 2 *and* 3) Divide the Difference, between the least Extream and half the common Difference of all the Terms by the said common Difference; reserve the Quotient: Then to the Square of the Quotient reserved add the Quotient, arising from dividing the doubled Sum of all the Terms by their common Difference, and extract the Square Root of the Sum, from which Root subtract if *Variety* 2, but add if *Variety* 3, the Quotient before reserved: The Sum and Difference, respectively, will be equal to the Number of Terms.

EXAMPLE.

In a Series of arithmetical Progressionals the least Extream is 6, the Sum of all the Terms 126, and their common Difference 4: *Query*, The Number of Terms.

This Example falls under Variety the second.

6	126
2	2
4)4	4)252
1*	63¼
1	
1	
63¼	
64(8	
√ 64 1*	
7 Answer	

C A S E XIII.

The greateſt Extream, Number, and Sum of all the Terms being given, to find the leaſt Extream.

RULE. From the Quotient ariſing from dividing the doubled Sum of all the Terms by their Number, ſubtract the greateſt Extream; the Difference will be equal to the leaſt Extream.

EXAMPLE.

In a Series of arithmetical Progreſſionals the greateſt Extream is 30, the Sum of all the Terms 126, and their Number 7: *Query*, The leaſt Extream.

```
 126
   2
------
7)252
------
  36
  30
------
   6 Anſwer
```

CASE XIV.

The greateſt Extream, Number of Terms, and their common Difference being given, to find the leaſt Extream.

RULE. From the Sum of the greateſt Extream and common Difference, ſubtract the Rectangle of the common Difference into the Number of Terms: the Difference ſo ſo found will be equal to the leaſt Extream.

EXAMPLE.

There are 7 Terms in arithmetical Progreſſion, their common Difference is 4 and the greateſt Extream 30: *Query*, The leaſt Extream.

```
30        7
 4        4
--       --
34       28
28
--
 6 Anſwer
```

CASE XV.

The common Difference, Number, and Sum of all the Terms being given, to find the least Extream.

RULE. To the Quotient arising from dividing the Sum of all the Terms by their Number, add half the common Difference, and from the Sum subtract half the Rectangle of the common Difference into the Number of Terms; the Difference so found will be equal to the least Extream.

EXAMPLE.

There are 7 Terms in arithmetical Progression, their common Difference is 4, and the Sum of all the Terms 126: *Query*, The least Extream.

```
7)126          7
  ---          4
   18         ---
    2        2)28
  ---          ---
   20           14
   14
  ---
    6
```

CASE XVI.

The greatest Extream, common Difference, and Sum of all the Terms being given, to find the least Extream.

Rule. To the Rectangle of the greatest Extream into the common Difference, add the Square of the greatest Extream; reserve the Sum; also reserve the Rectangle of the doubled Sum of all the Terms into the common Difference: then if the Sum and Rectangle reserved are alike, the common Difference is equal to the least Extream. But if the Sum reserved exceed the Rectangle reserved, to the said Sum add the Square of half the common Difference, and from the Total subtract the Rectangle before reserved; extract the Square Root of the Difference; which Root add to half the common Difference: the Sum will be equal to the least Extream.

But should the Sum reserved be less than the Rectangle reserved, in such Case add, and also subtract the Root found as above from half the common Difference: the Sum or the Difference so found will be equal to the least Extream: the Particulars of which may be thus obtained.

Take either the Sum or the Difference for the least Extream, and therewith find the Number of Terms. (per Case X.) If the Number of Terms so found be Negative or a mixed Number, the wrong Value of the least Extream is taken. But if the said Number of Terms prove integral, then find the Sum of all the Terms, according to Case I. If the Sum so obtained be equal to the Sum given, the right Value of the least Extream is taken; if not, the other is that required.

EX-

EXAMPLE.

In a Series of arithmetical Progressionals the greatest Extream is 30, the Sum of all the Terms 126, and their common Difference 4: *Query*, The least Extream.

30	30	126
4	30	2
120	900*	252
900*		4
1020		1008‡
4§	2)4	
1024	2†	
1008‡	2	
16 (4	4§	
16 2†		
6 Answer		

N. B. This Question falls under the second Observation.

CASE XVII.

The least Extream, Number, and Sum of all the Terms being given, to find the greatest Extream.

RULE. From the Quotient of the doubled Sum of all the Terms, divided by their Number, subtract the least Extream: the Difference will be equal to the greatest Extream.

EX-

EXAMPLE.

There are 7 Terms in arithmetical Progression, their Sum is 126, and the least Extream 6: *Query*, The greatest Extream.

```
  126
    2
 ----
7)252
 ----
   36
    6
 ----
   30 Answer
 ====
```

CASE XVIII.

The least Extream, common Difference, and Number of Terms being given, to find the greatest Extream.

RULE. To the Rectangle of the common Difference into the Number of Terms, add the least Extream; and from the Sum subtract the common Difference: the Difference so found will be equal to the greatest Extream.

EXAMPLE.

There are 7 Terms in arithmetical Progression, their common Difference is 4, and the least Extream 6: *Query*, The greatest Extream.

4
7
—
28
6
—
34
4
—
30
= Answer

CASE XIX.

The common Difference, Number, and Sum of all the Terms being given, to find the greatest Extream.

RULE; To the Rectangle of the common Difference into the Square of the Number of Terms, add the doubled Sum of all the Terms; and from the Sum so found subtract the Rectangle of the common Difference into the Number of Terms divide the Difference by double the Number of Terms: the Quotient will be equal to the greatest Extream.

EXAMPLE.

There are 7 Terms in arithmetical Progression, the Sum of all the Terms is 126, and their common Difference 4: *Query*, the greatest Extream.

126	7	7
2	7	4
252*	49	28‡
	4	
7	196	
2	252*	
14§	448	
	28‡	

§14)420(30 Answer
42
.0

C A S E XX.

The least Extream, common Difference, and Sum of all the Terms being given, to find the greatest Extream.

RULE. To the Square of the least Extream add the Square of half the common Difference, and also the Rectangle of the common Difference into the doubled Sum of all the Terms: then from the Sum hence arising subtract the Rectangle of the common difference into the least Extream, and extract the Square Root of the Remainder, from which Root subtract half the common Difference: the Difference so found will be equal to the greatest Extream.

EX-

EXAMPLE.

In a Series of arithmetical Progressionals' the Sum of all the Terms is 126, their common Difference 4, and the least Extream 6: *Query*, The greatest Extream.

6	2)4	126	6
6		2	4
	2§		
36	2	252	24†
4*		4	
1008‡	4*		
		1008‡	
1048			
24†			
1024 (32			
9 2§			
62)124 30 Answer			
114			

ARITHMETICAL PROPORTION, is when of three Terms the Sum of the Extreams is equal to double the Mean; or when of four Terms the Sum of the Extreams is equal to that of the Means, and is no other than Arithmetical Progression. Which see.

ARITHMETICIAN, one skilled in Arithmetic.

ARSEMETRICKE, Arithmetic.

ARTIFICIAL NUMBER, *Vide*, Logarithm.

ARTIFICIAL ARITHMETIC, is that which is performed by Logarithms.

AVOIRDUPOISE WEIGHT, is that by which all Kind of Grocery and Chandlery Goods

are weighed, and all Metals but Silver, and Gold. The Table is as follows.

Drms.	Oz.	lb	qr.	Cwt.	Fot.	Tons
16	1					
256	16	1				
7168	448	28	1			
28672	1792	112	4	1		
559104	34944	2184	78	19½	1	
573440	35840	2240	80	20	1 1/39	1

N. B. The Pound Avoirdupoise is equal to one Pound, two Ounces, eleven Penny-weights, fifteen Grains and an Half Troy.

AXIOM, a self-evident Principle, a known Truth; those of Arithmetic are as follow. *viz.*

I. *If to equal Quantities you add equal Quantities, the Sums will be equal.*

II. *If from equal Quantities you subtract equal Quantities, the Remainders will be equal.*

III. *If equal Quantities are multiplied by equal Quantities, the Products will be equal.*

IV. *If equal Quantities are divided by equal Quantities, the Quotients will be equal.*

V. *Quantities equal to one and the same Quantity, are equal to one another.*

VI. *Equal Quantities having the contrary Signs of more and less, destroy each other.*

N. B. The same is to be understood of numbers in general.

B

BALANCE (in personal, and Cash Accounts) is the Difference between the Total of the Sums which are debited, and the Total of those which are credited. ———

BARTER is the exchanging of one Commodity for another, in such a Manner, as neither of the Parties concerned may sustain Loss: for the effecting of which observe the following Cases.

CASE I.

When the Articles to be exchanged are single, and the Quantity, and Rate of each given, to find the Balance.

RULE. Find the Value of each Article according to its respective Rate, and Quantity; then will the Difference of the said Values be the Balance due to that Person whose Commodity amounted to the greatest Sum.

EXAMPLE.

A. Barters a Hhd. of Sugar, neat Weight, 12 C. 2 Q. 14 lb, at 2*l.* 6*s.* 4*d.* per Cwt. with B for two Bales of Muslin at 16*l.* per Bale; agreeing to even the Account with Money: *Query*, The Balance, and to whom due.

Qrs.		£.	s.	d.
2	½	2	6	4
				12
		27	16	0
lb 14	¼	1	3	2
			5	9½
		£. 29	4	11½

£.		
16		
2		
32	0	0
29	4	11½
£. 2	15	0½ Answer

Due to B.

CASE II.

When the Articles to be exchanged are single, and the Rate of each, and the Quantity of one of them, given, to find the corresponding Quantity of the other.

RULE. Find the Value of that Article whose Quantity is known according to its given Rate; then find how much of the Article, whose Quantity is required, may be had, at its respective Rate, for the aforesaid Value of the former Article; the Quantity so obtained will be that required.

EXAMPLE.

How much Tea at 5*s.* 2*d.* per lb can I have in Barter for 3C. 2Qr. 16lb of Sugar, at 1*l.* 17*s.* 4*d.* per Cwt.

Qrs.

		£.	s.	d
2 Qrs.	½	1	17	4
16 lb	½			3
		5	12	0
			18	8
			5	4
		£. 6	16	0

s. d. lb £. s.
As 5 ; 2 : 1 :: 6 16
12 20
62 136
12

62)1632(26 lb 5 Oz. 2 $\frac{36}{62}$ Dr. Answer
124
392
372
20
16
62)320(5 Oz.
310
10
16
62)160 (2 $\frac{36}{62}$ Drms.
124
36

N. B. If either of the Parties advance the Rate of their Goods above the current Price, the other Party ought also to advance the Rate of his Goods proportionably; which may be thus performed.

Rule. As the current Price of either Article is to its advanced Rate, so is the current Price of the other Article to its equivalent advanced Rate.

Case the second and Case the third prove each other.

CASE III.

When the Articles to be exchanged are single, and the Quantities of each, and the Rate of one of them given, to find the Rate of the other.

Rule. Find the Value of that Article whose Rate is known, and then by Proportion, as the given Quantity of that Simple whose Rate is required, is to the Value before found; so is the proposed Quantity by which the Rate is to be expressed, to the Rate required.

EXAMPLE.

A gives in Barter a Hhd. of coarse Sugar, Wt. 10 C. 1 Qr. at $3\frac{1}{2}d$ per ℔, to B for 574℔ of Currants: *Query*, How B rated his Currants per Cwt.

As

```
  lb    d.      Cwt. Qr.
As 1 : 3¼  ::  10.  1
       4         4
      ---       ---
      13        41
      ==        28
               ---
               328
                82
               ----
              1148
                13
              ----
              3444
              1148
  lb                  lb
As 574 :: 14924 :: 112
              112
            ------
            179088
            14924
            -------4
574)1671488(2212
    1148            12)728(8
    ----
     5234           ------
     5166           2|0)6|0
     ----
      688           £ 3  0  8 Answer
      574           ============
     ----
     1148
     1148
     ====
```

N. B. If the Answer to the Question according to the above Rule be the advanced

vanced Rate, the current Price may be found thus.

Rule. As the advanced Rate given is to its current Price; so is the Rate found as above, to the current Price required.

CASE IV.

When a single Article, whose Rate, and Quantity are given, is to be exchanged for two other Articles, of which the Rate of each, and the Quantity of one of them being also given, to find the corresponding Quantity of the other.

Rule. Find the Balance between those two Articles whose Rates and Quantities are known (according to Case I) then find how much of the Article whose Quantity is required may be had, at its respective Rate, for the aforesaid Balance. (per Case II.) the Quantity so found will be that required.

This Case and Case V. prove each other.

EXAMPLES.

A Barters 16C. of Sugar at 2*l.* 10*s.* per C. with B. for 50℔ of Tea, at 14*s.* 2*d.* per ℔; and for the Balance takes Coffee at 5*s.* 7*d.* per ℔. The Quantity of Coffee is required.

s.	d.		£	s.	
14	2		2	10	
	10			8	
7 1	8		20	0	
	5			2	
£35 8	4¼		40	0	0
			35	8	4¼

s. d. ℔

As 5 7 : 1 : 4 11 8

12 20

67)1100*(16 ℔ 91

67 12

430 1100*

402

28 ℔ Oz.

16 16 6 $\frac{46}{67}$ Answer.

162

28

67)448(6$\frac{46}{67}$ Oz.

408

46

X. hath 320 Bottles of Claret at 4*s.* 6*d.* per Bottle; for which Z. gives him 30*l.* in Cash and the Rest in refined Sugar at 8*d.* per ℔: *Query*, How much Sugar Z. gave to X.

```
s.
4 | 1/5 | 320
d.      ------
6 | 1/8 |  64
        |   8
        ------
           72l.
           30
d.  lb   ------
As 8 : 1 :: 42 £.
           20
         ------
           840
            12
        --------
       8)10080
        -------  4
      28)1260(45(
          112   ---- Qr.
        -------  11  1 Answer
          140 ====
          140
         =====
```

C A S E V.

When a single Article, whose Rate and Quantity are given, is to be exchanged for two other Articles; of which the Quantity of each and the Rate of one of them being also given, to find the Rate of the other.

RULE. Find the Ballance between those Articles whose Rates and Quantities are given. (Per Case I.) Then as the Quantity of that Article whose Rate is required, is to the

the said Ballance, so is the Quantity whereby the Rate is to be expressed, to the Rate required. (Per Case III.)

EXAMPLE.

X. hath 320 Bottles of Claret at 4*s.* 6*d.* per Bottle, for which B gives him 3 Hhds. of Cyder at 10*l.* per Hhd. and 11C. 1Qr. of refined Sugar: *Query*, How B. rated his Sugar per ℔.

```
 s.
 4 | 1/5 | 320                          £.
 d.|     | ----                         10
 6 | 1/8 |  64                           3
   |     |   8                          ---
   |     | ----                         30.
          £.72                          ===
            30.
  C. Qr.  ----                  ℔
As 11 1    42       ::           1
    4      20
  ----    ----
   45     840
   28      12
  ----    ---- d.
  360  ‡126|0)1008|0(8 Answer
   90         1008
  ----        ====
 1260‡
 ====
```

BEER MEASURE. The Standard for this Measure is the same as that of Ale. Vide the Table.

Cub. In.	Pints	Qts.	Galls	Fir.	Kil.	Bar	Hds.	But.
35¼	1	—	—	—	—	—	—	—
70½	2	1	—	—	—	—	—	—
282	8	4	1	—	—	—	—	—
2538	72	36	9	1	—	—	—	—
5076	144	72	18	2	1	—	—	—
10152	288	144	36	4	2	1	—	—
15228	432	216	54	6	3	1½	1	—
30456	864	432	108	12	6	3	2	1

BINARY ARITHMETIC, is that wherein an Unit and Cypher only (*Viz.* 1 and 0) are made Uſe of, and inſtead of the Unit's Value being increaſed or decreaſed in a tenfold Proportion, by the annexing or prefixing of a Cypher, or Cyphers, to it, as in common Arithmetic, it is here only increaſed or decreaſed by the ſimple Addition of 2. Vide *Leibnitz*, and alſo *Pelican's Arithmeticus Perfectus*.

BINARY NUMBER, that which is compoſed of two Units.

BIPARTIENT NUMBER, is ſuch as ariſes from the Diviſion of any even Number by 2.

BIQUADRATE NUMBER, is that which exactly contains the fourth Power of its Root.

BROKEN NUMBERS, ſee Fractions.

BROKERAGE, is an Allowance from 1*s.* to 10*s.* &c. per Cent. uſually made by Merchants, &c. to Perſons called Brokers, for procuring them Cuſtomers or for ſelling their Goods.

The Brokerage of Goods amounting to any Sum may be readily obtained by the following RULE.

Divide

Divide the given Sum by 100, and take Parts of the Quotient according to the Rate per Cent. (as in Practise) The Result will be the Brokerage required.

EXAMPLE.

Suppose a Broker sells Goods to the Amount of 824*l.* 10*s.* 6*d.* what may he Demand for Brokerage, when he is allowed 7*s.* 6*d.* per Cent. for his Trouble?

£.	s.	d.	s.	d.		£.	s.	d.
8|24	10	6	5	0	$\frac{1}{4}$	8	4	10$\frac{3}{4}$
20								
			2	6	$\frac{1}{2}$	2	1	2$\frac{1}{2}$
4|90						1	0	7$\frac{1}{4}$
12								
						£. 3	1	9$\frac{3}{4}$ Ansr.
10|86								
4								
3|44								

C

CALCULATION, reckoning, casting Accompts.

CANON, a particular Rule whereby Questions of the same Kind only can be resolved.

CARDINAL NUMBERS, are such as express the Quantity of Units, or Number of Things.

CENT. A Contraction of the Latin Word *Centum*, by the Hundred.

CHA-

CHARACTERS, Marks, Signs, or Simbols of certain Things, adapted to peculiar Sciences. Those chiefly made Use of in Arithmetic are as follow.

=

This Sign being placed between two Numbers, Sums or Quantities, denotes them to be equal.

+

This Sign being prefixed to any Number, Sum, or Quantity, denotes it to be Affirmative; but when placed between two Numbers, Sums or Quantities, it signifies their Addition.

—

This Sign being prefixed to any Number, Sum, or Quantity, denotes it to be Negative; but when placed between two Numbers, Sums, or Quantities, it signifies that which follows it, to be subtracted from that which precedes it.

×

This Sign being placed between any two Numbers, Sums, or Quantities, denotes their Multiplication.

÷

This Sign being placed between two Numbers, Sums, or Quantities, denotes, that which precedes it to be divided by that which follows it.

$::$

This Sign placed in the middle of four Terms denotes them to be Proportional.

$\surd$.

This Sign being prefixed to any Number, or Quantity, signifies its Root is required; the Denomination of which is always expressed by having the Index of its Power placed within the Sign, as $\sqrt[2]{}$ or $\surd$ for the Square Root. $\sqrt[3]{}$ for the Cube Root, &c.

$$\overline{4+2}^{2} = 36$$

The Power of any Root is expressed by drawing a Vinculum over it with the Index of the Power affixed to it.

$$2 - \overline{7-6} = 1$$

A Vinculum drawn over two or more Numbers, Sums, or Quantities, denotes them to be first wrought.

$$\sqrt{6+\overline{12 \div 4}} = 3$$

The Vinculum that stands nearest the Numbers, or Quantities, always produces its Effects first.

$\sqsupset$

This Sign being placed between any two Quantities, denotes that which follows it to be greater than that which precedes it.

This

⊏

This Sign being placed between any two Quantities, denotes that which follows it to be less than that which precedes it.

∽

This Sign placed between any two Quantities, signifies their Difference without any Respect being paid to that which is greatest or least.

CHARACTERISTIC (of a Logarithm) the same as Index, which see.

CHILIADS, The Tables of Logarithms.

CIRCULAR NUMBERS, are such whose Powers end in the Roots themselves.

CLOFF, an Allowance of 2 lb to every 3 Cwt. of some Sorts of Goods for the Turn of the Scale.

CLOTH MEASURE, is a Measure of Length, and is chiefly used by Mercers, Drapers, Haberdashers, &c. in measuring their Silks, Cloths, Linens, Tapes, &c. The several Denominations of this Measure are as follows.

Inch.	Nails	Qrs.	Flem. Ells.	Yds.	Eng. Ells.
$2\frac{1}{4}$	1	——		——	
9	4	1	——	——	——
27	12	3	1	——	——
36	16	4	$1\frac{1}{3}$	1	——
45	20	5	$1\frac{2}{3}$	$1\frac{1}{4}$	1

COEFFICIENT, (in specious Arithmetic) the known Quantity or Number that is Multiplied into any of the unknown Quantities.

COMBINATION, is the Union of two or more Persons or Things: Also a Rule which teaches

teaches how to find all the poſſible Combinations that any Number of Things is capable of producing.

C A S E I.

Is when a Number of Things being propoſed, and alſo the Number of which a Combination is ſuppoſed to conſiſt; it is required to find how many different Ways ſuch a Combination may be formed out of the ſaid Number of Things propoſed.

RULE. Place the given Number of Things above a Line, and the Number of which the Combination conſiſts below the Line; *(Fraction-wiſe)* make this Fraction the firſt Term in a Series of Fractions whoſe Numerators and Denominators decreaſe continually by an Unit, until the laſt Denominator is 1; then multiply all the Numerators together for a Dividend, and all the Denominators together for a Diviſor, the Quotient hence ariſing will be the Number of all the poſſible Variations of the ſaid Combination.

E X A M P L E.

A Gentleman having 20 Servants, gives Orders for ſome four of them to attend him: *Query*, In how many different Ways it is poſſible for them to obey his Command.

$\frac{20 \times 19 \times 18 \times 17}{4 \times 3 \times 2 \times 1} = 5 \times 19 \times 17 \times 3 = 95 \times 51 = 4845$ Ans

$$\frac{20}{4}\times\frac{19}{3}\times\frac{18}{2}\times\frac{17}{1}$$

```
   17                    1
   18                    2
  ----                  --
  136                    2
   17                    3
  ----                  --
  306                    6
   19                    4
  ----                  --
 2754                   24*
 306
 ----
 5814
   20
 ----
*24)116280(4845 Answer
    96
    ---
    202
    192
    ---
     108
      96
     ---
      120
      120
      ---
```

Here the given Number of Things is 20, that of the Combination 4, and the different Ways in which such Combination is capable of being formed (not having any two alike) are 4845; which seem almost incredible, and beyond the Conception of such as are not well acquainted with Numbers.

CASE

CASE II.

Is when a Number of Things being given, it is required to find the Number of all the possible Combinations which the said given Number is capable of producing.

RULE. To the given Number add an Unit; reserve the Sum: Then raise the Number 2 to a Power whose Index is equal to the said given Number, and from the Power so raised, subtract the Sum reserved; The Difference will be equal to all the possible Combinations.

EXAMPLE.

How many different Combinations may be formed out of 6 Persons.

```
 2      6
 2      1
---    ---
 4      7*
 2     ===
---
 8
 8
---
64
 7*
---
57 Answer
==
```

Proof by Case I.

```
   15 of 2
   20 — 3
   15 — 4
    6 — 5
    1 — 6
   --
Total 57 as before
   ==
```

COMMENSURABLE NUMBERS, are such as are capable of being divided, without leaving a Remainder, by some other Number greater than Unity.

COMMISSION, a Warrant, or Licence, under which a Person acts; also an Order by which a Factor transacts the Business of his Employer. *Vide Factorage.*

COMMON DIVISOR, a Number (greater than Unity) that divides two or more Numbers without leaving any Remainder.

COMMUTATION, the same as Barter, which see.

COMPARISON of WEIGHTS and MEASURES, see Conjoined Proportion.

COMPOSITE NUMBERS, are the same as Commensurable Numbers.

COMPOUND ADDITION, see Addition of Money, Weight, &c.

COMPOUND DIVISION, see Division of Money, Weight, &c.

COMPOUND INTEREST, is that which arises from any Principal and its Interest taken together as it still becomes due; that is the Amount of the first Year becomes the Principal of the second Year, and the Amount of the second, the Principal of the third, &c.

CASE I.

The Principal, Rate per *Cent.* per *Annum*, and the Time the Principal has continued at Interest being given, to find the Compound Interest due upon the said Principal.

RULE. Find the Amount of the given Principal for one Year, as in simple Interest, make that Amount the Principal of the second, and find its Amount for one Year as before; which make the Principal of the

third

third Year, and so on to the given Number of Years: then from the last Amount subtract the given Principal: The Difference will be the Compound Interest.

EXAMPLE.

What is the Compound Interest of 350l. for 3 Years at 5l. per Cent. per Annum?

```
 £350          £350
    5            17 10
 -----         ---------
 17|50         367 10  Amount of 1st Year.
    20                5
 -----         ---------
  10|00        18|37 10
                  20
               ---------
 £.  s. d.       7|50
 367 10 0          12
  18  7 6        ----
 ---------       6|00
 385 17 6 Amount of the second Year
          5
 ---------
 19|29 7 6       £.  s. d.
   20            385 17 6
 -----            19  5 10½
  5|87           -----------
   12            405  3  4½ Amt. 3d Year
 -----           350
 10|44           -----------
    4             55  3  4½ Answer
 -----           -----------
  2|08
```

N. B.

N. B. The Compound Intereſt of any Sum may be readily found by Caſe I. of *Annuities in Arrear*, by making the Intereſt of the given Sum for one Year the *Annuity*, the Years it has continued at Intereſt, the *Times* of Forbearance, and the Compound Intereſt the *Amount*.

EXAMPLE.

Suppoſe the foregoing Queſtion.

£ 350	£ 17 s. 10 = £ 17,5	1,05
5		1,05
17|50		525
20		105
s. 10|00		1,1025
		1,05
,05)2,7584375*(		55125
£55,16875		11025
20		1,157625
s. 3,37500		1,
12		,157625
d. 4,50000		17,5
4		788125
2,00000		2679625
		2,7584375*

£ s. d.
55 3 4½ Anſr.

CASE

CASE II.

The Principal, Rate, and Time being given, to find the Amount.

RULE. Raise the Ratio to a Power whose Index is equal to the given Number of Years, and multiply the Power so raised by the Principal: The Product will be the Amount.

N. B. If you subtract the Principal from the Amount, the Difference will be the Compound Interest.

EXAMPLE.

What will 350*l.* amount to in three Years at 5*l.* per Cent. per Annum Compound Interest?

```
      1,05
      1,05
      ----
       525
     105
    ------
    1,1025
      1,05
    ------
     55125
   11025
  --------
  1,157625
       350
  --------
  57881250
 3472875
 ----------
£405,168760 = 405  3  4¼ Answer.
```

(£ s. d. over 405 3 4¼)

CASE III.

The Amount, Rate, and Time, being given, to find the Principal.

RULE. Raise the Ratio to a Power whose Index is equal to the given Number of Years, and with the said Power divide the Amount: The Quotient will be the Principal.

EXAMPLE.

What Principal will amount to 405*l.* 3*s.* 4½*d.* in 3 Years, at 5*l.* per Cent. per Annum, Compound Interest.

```
  1,05
  1,05          £.  s.  d.
 ------         405 3 4½ = 405,168750*
   525
  105
 ------
 1,1025
   1,05
 ------
  55125
 11025
 --------
1,157625(405,169750*(350 Answer
         347 2875
         --------
          5788125
          5788125
         --------
               .0
```

CASE IV.

The Principal, Rate, and Amount being given, to find the Time.

RULE. Divide the Amount by the Principal; the Quotient will be a Power of the Ratio whose Index is equal to the Number of Years required; therefore divide the said Power and the successive Quotients continually by the Ratio until the last Quotient is an Unit, and the Remainder 0; the Number of those Divisions will be equal to the Years sought.

EXAMPLE.

In what Time will 350*l.* amount to 405*l.* 3*s.* 4½*d.* at 5*l.* per Cent. per Annum?

£.	s.	d.		£.
405	3	4½	=	405,16875

```
                1,05          1,05      1,05(1
350)405,16875(1,157625(1,1025(1,05
    350         1,05         1,05      1,05
    ---         ----         ----      ====
    551          107          525
    350          105          525
    ---          ---          ---
    2016          262
    1750          210
    ----          ---
     2668          525
     2450          252
     ----          ---
      2187
      2100
      ----
       875
       700
       ---
       1750
       1750
       ====
```

Answer. Three Years; equal to the Number of Divisions.

CASE V.

The Principal, Time, and Amount being given to find the Rate.

RULE. Divide the Amount by the Principal; the Quotient will be a Power of the Ratio whose Index is equal to the given Years; therefore extract the Root of that Power; from which Root subtract an Unit, and

and multiply the Difference by 100: The Product will be the Rate per Cent. per Annum.

EXAMPLE.

At what Rate per Cent. per Annum, compound Interest, will 350*l.* amount to 405*l.* 3*s.* 4½*d.* in three Years?

£	s.	d.		£
405	3	4½	=	405,16875

```
350)405,16875(1,157625
    350
    ---
     551
     350
     ----
     2016
     1750
     ----
      2668
      2450
      ----
       2187
       2100
       ----
         875
         700
         ----
         1750
         1750
         ====
```

Continued in the next Page.

Continued from the foregoing Page,

		$\sqrt[3]{1,157625}$ =	1,05
1×1×1	=	1	1,
1×1×3	=	3) 1	,05
			100
10×10×10	=	1,000	
			£ 5, Answer
10×10×3	=	300) 1576	
1,05×1,05×1,05	=	1,157625	
		....	

COMPOUND MULTIPLICATION, see *Multiplication of Money, &c.*

COMPOUND NUMBERS, are the same as *Composite Numbers.*

COMPOUND PROPORTION, is when of four Terms, the Sum of the first Antecedent and the first Consequent, is to the said Antecedent, or Consequent; as the Sum of the last Antecedent and the last Consequent, is to the said last Antecedent, or Consequent, respectively.

COMPOUND RATIO, is that which the Product of the Antecedents of two or more Ratios has to the Product of their Consequents.

COMPOUND REDUCTION, is that which requires the Application of Reduction ascending and descending. It is always known by an Unit of the Denomination required, being an aliquant Part of an Unit of the Sum

Sum or Quantity given. The Rule is this.

Reduce ſeverally the given Sum, or Quantity, and alſo an Unit of the Denomination required, to one and the ſame Name (per *Reduction Deſcending*) and divide the Reſult of the given Sum, or Quantity, by that of the Unit: The Quotient will be the Anſwer.

EXAMPLE.

	£	s.	d.	
In	25	6	8	how many Marks?

s.	d.
13	4
12	
160*	

£	s.	d.
25	6	8
20		
506		
12		

16|0*)608|0(38 Anſwer
48
—
128
128

N. B. When an equal Number, or Quantity of Things, of ſeveral Denominations are required, add the Units of the ſeveral Things propoſed

proposed together, and proceed with their Sum according to the general Rule.

EXAMPLES.

In 47*l.* 4*s*, how many Marks, Crowns, Shillings and Groats, and of each an equal Number?

s.	*d.*		£	*s.*
13	4		47	4
5	0		20	
1	0		944	
0	4		12	
19	8		236*)11328(48 Answer	
12			944	
236*			1888	
			1888	

PROOF.

48	Marks	=	32	0
48	Crowns	=	12	0
48	Shillings	=	2	8
48	Groats	=	0	16
	Total	£	47	4 as above

COMPOUND SUBTRACTION, see *Subtraction of Money*, &c.

COMPOUND VULGAR FRACTIONS, are Fractions of Fractions, connected together, by having the Word *of* placed between the fractional Parts; as $\frac{7}{8}$ of $\frac{3}{5}$ of $\frac{2}{9}$ &c.

COM-

COMPUTATION, reckoning, casting up Accounts.

COMPUTANT, an Accomptant.

CONCRETE NUMBERS, are such as express some particular Subject or Thing. The Contrary of Abstract Numbers.

CONJOINED PROPORTION, is when the Monies, Weights, or Measures, of several Places are compared together in the same Question. This admits of two Cases.

CASE I.

The Terms of Comparison being given, to find what Number, or Quantity, of the Things of the first mentioned Place are equal to a proposed Number, or Quantity, of those of the last-mentioned Place.

RULE. Let the given Terms of Comparison be placed one under another in two regular Columns; the first Term being set toward the left Hand, and the second toward the Right; and so on alternately, from left to right, in the natural Order as they occur in the Question: Then multiply the proposed Number, or Quantity, and all the Terms in the left hand Column continually together for a Dividend, and all those in the right hand Column together for a Divisor: The Quotient hence arising will be the Answer.

EXAMPLE.

If 50℔ at *London* are equal to 44℔ at *Nurenburgh*; 176℔ at *Nurenburgh* to 184℔ at *Hamburgh*; 92℔ at *Hamburgh* to 98℔ at

at *Lyons*; how many Pounds at *London* are equal to 49 lb at *Lyons*?

lb		lb
50	—	44
176	—	184
92	—	98

44	50
184	176
176	8800
352	92
44	17600
8096	79200
98	809600
64768	49
72864	7286400
793408*	3238400

lb

793408*)39670400(50 Anſw.
3967040

.0

C A S E II.

The Terms of Compariſon being given to find what Number, or Quantity, of the Things of the laſt mentioned Place are equal to a propoſed Number, or Quantity, of thoſe of the firſt-mentioned Place.

Rule. The Terms of Compariſon being placed as in Caſe I. multiply the propoſed Number, or Quantity, and all the Terms in

in the right Hand Column continually together for a Dividend, and all thoſe in the left Hand Column for a Diviſor: The Quotient hence ariſing will be the Anſwer.

EXAMPLE.

If 50℔ at *London* are equal to 44℔ at *Nurenburgh*; 176℔ at *Nurenburgh* to 184℔ at *Hamburgh*; 92℔ at *Hamburgh* to 98℔ at *Lyons*: How many Pounds at *Lyons* are equal to 100℔ at *London*?

℔		℔
50	——	44
176	——	184
92	——	98

```
     50          44
    176         184
  -----        ----
   8800         176
     92         792
  -----        ----
  17600        8096
  79200          98
 ------       -----
 809600       64768
 ======       72864
              -----
             793408
                100
```

8096|00)793408|00(98℔ Anſwer
72864
———
64768
64768
=====

CONSEQUENT *(in Proportionals)* is the latter of any two Terms that are immediately compared with each other.

CONVERSION of RATIOS, is the comparing the Antecedent with the Difference of the Antecedent and Consequent.

CROSS MULTIPLICATION, see Duodecimals.

CUBE NUMBER, the third Power of the Root.

CUBED CUBE NUMBER, the ninth Power of the Root.

CUBIC MEASURE, is that which is used in estimating the Bulk or Magnitude of Bodies, and the Capacities of Vessels in General. *Vide the Table.*

Qrs. of a Cub. In.	Cub.In.	Cub. Ft.	Cub. Yd.
64	1	—	—
110592	1728	1	—
995328	15552	9	1

CYPHER, the Character (o) This Character when it stands alone signifies Nought or Nothing, but when annexed to a whole Number, it increases the Value thereof in a tenfold Proportion; and when prefixed to a Decimal it decreases the Value thereof in the same Proportion. *Vide Notation and Numeration.*

D

DECADE, the Number of ten.

DECIMAL, of or belonging to ten.

DECIMAL ARITHMETIC, is that which treats of decimal Numbers.

DECIMAL FRACTION, is ſuch whoſe Denominator is not expreſſed, it being always underſtood to be ten, or ſome Power thereof, *viz.* An Unit with as many Cyphers annexed to it, as there are Places in the decimal Fraction given; and is diſtinguiſhed from a whole Number by having a Comma prefixed to it.

DECIMAL NUMBERS, are ſuch as conſiſt of Tens. *Viz.* Decimal Fractions.

DECUPLE, ten-fold.

DEDUCT, ſubtract or take from.

DEFECTIVE } NUMBER, is ſuch that the
DEFICIENT } Sum of it's aliquot Parts is leſs than the Number itſelf.

DEMAND (in the Rule of Three) is that Part of a Propoſition wherein the Queſtion is aſked. How much? How many? What will? &c.

DENOMINATION, a Name of any particular Thing.

DENOMINATOR (of a Vulgar Fraction) is the lower Term, ſo called, becauſe it denotes the Number of Parts into which the Integer is ſuppoſed to be divided.

DIFFERENCE (in Subtraction) is the Exceſs of the Minuend above the Subtrahend.

DIGIT, either of the nine primitive Numbers, or Characters, 1, 2, 3, 4, 5, 6, 7, 8, 9.

DIMIDIATION, a dividing into two equal Parts.

DIMIDIETAS, the one half.

DINUMERATION, a Numbering or Accounting.

DIRECT PROPORTION, *(in the Rule of three)* is when the Ratio of the fourth, and second Terms; and the Ratio of the third, and first Terms, are alike. Or *(in the double Rule of Three)* when the Ratio of the sixth, and third Terms; and the Ratio of the Rectangles, of the fourth, and fifth; and of the first and second Terms, are the same.

N. B. The Proportion is known to be Direct when more requires more; that is, when the third Term is greater than the first; and the fourth Term is required to be greater than the second.

Also, Less requiring Less, denotes the Proportion to be Direct; that is, when the third Term is less than the first; and the fourth Term is required to be less than the second.

DISCOUNT, is an Allowance of so much per Cent. made by the Receiver upon the prompt Payment of any Sum not yet due, and is two-fold with Respect to Time, *viz.* In discounting Notes and Bills of Exchange, the Time is most commonly considered. But in the Discount upon Goods presently bought, the Time is seldom (if ever) taken Notice of. The common Method of finding the

Discount

Difcount of any Sum, and for any Time, is as follows.

Rule. Find the Intereft of 100*l.* at the propofed Rate per Cent. and for the Time before the given Sum becomes due, add the Intereft fo found to 100*l.* then as that Sum is to the faid Intereft, fo is the given Sum to the Difcount required.

EXAMPLE.

What is the Difcount of a Note of 30*l.* due 9 Months hence, at 5*l.* per Cent. per Annum.

		£.	
6	½	5	
3	½	2	10
		1	5
		3	15
		100	

£	s.		£	s.		£
£103	15	:	3	15	::	30
20			20			20
2075			75			600
			600			
			45000			

Contined in the next Page.

```
                  2|0
2075)45000*(2|1
     4150
     ----         £1 : 1 : 8 Answer
     3500
     2075
     ----
     1425
       12
     ----
2075)17100(8
     16600
     -----
       500
```

N. B. Subtract the Discount from the given Sum; the Difference will be the present Worth. *See more of this under* Rebate *or* Discount.

DISCRETE } DISJUNCT } PROPORTION, is when of four Terms, the Ratio of the first and second, is the same as that of the third and fourth: But different from that of the second and third.

DIVIDEND (in Division) is the Number, Sum, or Quantity to be divided.

DIVIDUALS, those Figures, or Numbers, that are taken down severally from the Dividend, and which are usually distinguished by Points.

DIVISION, is a Rule which teaches to find how often any Number, Sum, or Quantity, is contained in some other Number, Sum, or

or Quantity, and is the direct Converse of Multiplication, and consequently a compendious Way of Performing many repeated Subtractions.

DIVISION of DECIMALS, is performed in the same Manner as that of Integers: only Note,

I. That there must be as many decimal Places (at least) in the Dividend as there are in the Divisor; if not, the Defect must be supplied by annexing a competent Number of Cyphers to it.

II. That there must be as many Places pointed off toward the right Hand of the Quotient (for a Decimal) as are equal to the excess of the decimal Places of the Dividend, above those of the Divisor.

III. If the Quotient does not consist of so many Places as are equal to the Excess of the decimal Places of the Dividend above those of the Divisor, the Defect must be supplied by prefixing as many Cyphers to it as make the Places equivalent.

IV. When the Decimal Places in the Dividend are equal to those in the Divisor: The Quotient will be a whole Number.

EX-

EXAMPLES.

Divide 46,5275
by 2,5.

```
2,5)46,5275(18,611
    25
    ---
    215
    200
    ---
     152
     150
     ---
       27
       25
       --
        25
        25
        --
```

Divide ,00615
by ,5.

```
,5),00615
    -----
    ,0123
    =====
```

Divide 376075
by ,0025

```
,0025)
```

```
,0025)376075,0000(150430000
      25
      ---
      126
      125
      ---
        107
        100
        ---
          75
          75
          ---
          .0000
          =====
```

DIVISION of INTEGERS, is the dividing of one whole Number by another, and is thus performed.

Place the Dividend between a reversed Parenthesis, and the Divisor on the Outside thereof towards the left Hand: this done; find how often the Divisor is contained in as many Figures, or Places, of the Dividend as the Divisor consists of,* and put the Figure expressing the Times in the Quotient (*viz.* on the Outside of the Parenthesis towards the right Hand) Multiply the Divisor by the Figure put in the Quotient, and subtract the Product from the Figures, or Places, taken in the Dividend, and increase the Remainder by annexing the next occur-

* If the Number expressed by the Figures, or Places, taken in the Dividend, is less than the Divisor, one Figure, or Place, more of the Dividend must be taken.

ring Figure, or Dividual of the Dividend to it. Find how often the Divisor is contained in the Remainder so increased, and set the Figure denoting the Times in the Quotient,‡ multiply the Divisor by the Figure last set in the Quotient, and subtract the Product from the aforesaid increased Remainder, and to the Difference annex the next occurring Figure, or Dividual, of the Dividend. Proceed in every Respect as above until all the Figures of the Dividend are taken, and if there be any Remainder at last, it must be made the Numerator of a Vulgar Fraction whose Denominator is the given Divisor; which Fraction must be annexed to the Quotient, and the Work is finished.

N. B. If either, or both the Dividend, and Divisor are affected with Signs; observe,

I. If the Signs are alike, that is both Affirmative, or both Negative; the Quotient will be an affirmative Number.

II. If the Signs are unlike; that is, If either of them be Affirmative and the other Negative; the Quotient will be a negative Number.

The like is to be understood in all Kinds of Division.

EX-

---

‡ If the Remainder so increased is less than the Divisor, set a Cypher in the Quotient, and annex to the said Remainder the next occurring Figure, or Dividual of the Dividend, and proceed as above.

EXAMPLES.

Divide 4687451
by 462.

```
462)4687452(10146
    462
    ---
      674
      462
      ----
      2125
      1848
      ----
       2772
       2772
       ====
```

Divide 67296942,
by 369.

```
369)67296942(182376 198/369
    369
    ----
    3039
    2952
    ----
     876
     738
     ----
     1389
     1107
     ----
      2824
      2583
      ----
       2412
       2214
       ----
        198
        ====
```

Divide — 26942
by — 69

```
—69)—26942(+390 32/69
     207
     ---
      624
      621
      ---
       32
       ==
```

Divide

Divide + 34627
by — 72.

$$-72)+34627(-480\tfrac{67}{72}$$
$$\begin{array}{r} 288\;\;\\ \hline 582 \\ 576 \\ \hline 67 \\ \hline\hline \end{array}$$

N. B. Had the Divisor been Affirmative, and the Dividend Negative, the Quotient would then also have been a Negative Number as above.

Notwithstanding I have already given a general Rule for Division of Integers, it may not be improper to insert the following Cases, as they may serve in some Measure to facilitate the practical Operations.

CASE I.

When the Divisor is a Number not exceeding 12.

RULE. Place the Dividend and Divisor in a like Manner to that taught in the general Rule, and draw a Line under the same. Find how often the Divisor is contained in the first Figure (or rather a competent Number of Figures) of the Dividend, and set the Figure expressing the Times, below the Line exactly under the furthermost Place taken in the Dividend; observing at the same Time to add (in your Mind) as many Tens to the

next

next occurring Figure, or Dividual, of the Dividend, as there are Units in the odd, or Remainder; find how often the Divisor is contained in the Sum, and proceed in every Respect as above. If the said Sum should be less than the Divisor, put a Cypher below the Line, and take one Figure, or Dividual, more of the Dividend, and so on until the whole is finished.

EXAMPLE.

Divide 4627046
by 11.

11)4627046(6 the Remainder

420640 the Quotient.

CASE II.

When the Divisor is a Rectangle of some two Numbers, neither exceeding 12.

RULE. Divide the Dividend by either of those Numbers, as in Case I. and the Quotient thence arising by the other Number: The last Quotient will be that required.

EXAMPLE.

Divide 781242
by 77.

77=

77 = 11 × 7)781242(

11)111606(

10146 the Quotient

C A S E III.

When there are Cyphers annexed to the Divisor.

Rule. Point them off, and also Point off an equal Number of Places towards the right Hand of the Dividend. Omit the Cyphers, and Places pointed off, in the Operation; and proceed as the Case requires, according to the foregoing Rules.

N. B. The Places pointed off in the Dividend must be annexed to the last Remainder.

E X A M P L E.

Divide 4627694
by 37500

375|00)46276|94(123 $\frac{15194}{37500}$
375
877
750
1276
1125
15194

DIVISION of MONEY, WEIGHT and MEASURE, is the dividing of any Sum, or Quantity, by some certain Number. The Rule is as follows.

Place the Dividend and Divisor as in Division of Integers, and divide the first, or greatest, Denomination, according to the same Rule. Multiply the Remainder by as many Units of the next succeeding Denomination in the Dividend, as are equal to an Unit of the said Remainder, and to the Product add the Particulars expressed in the aforesaid next succeeding Denomination, of the Dividend; Divide the Sum as before taught; observing at the same Time to put the respective Quotients apart; proceed in every Respect as above, until the whole is finished.

N. B. The Remainder, and Quotient, is always of the same Name as the Denomination under Operation.

EXAMPLE.

	£.	s.	d.
Divide	136	12	4
by 43			

```
     £.   s.  d.   £. s. d.
43)136  12  4  (3  3  6½, 2/43
   129
   ———
     7
    20
   ———
43)152
   129
   ———
    23
    12
   ———
43)280
   258
   ———
    22
     4
   ———
43)88
   86
   ——
    2
   ==
```

N. B. Sometimes the Work may be shortened by attending to the particular Cases in Division of Integers, and by performing the Multiplications or Reductions, in the Mind only.

EXAMPLE.

Bought 35 Firkins of Butter for 26*l*. 15*s*. 2½*d*. What was it per Firkin?

	£.	s.	d.
35 = 7 × 5)26	16	2½
7)5	7	0½
£ 0	15	3½ Answer

DIVISION of VULGAR FRACTIONS, admits of two Cases. *First*, When the Dividend and Divisor are simple Fractions, and of the same Denomination. *Secondly*, When either, or both the Dividend and Divisor consist of Fractions of several Kinds, and of more Denominations than one; but all subject to the same principal Integer. The general Rule is as follows.

In the first Case, Multiply the Denominator of the Divisor, by the Numerator of the Dividend: The Product will be the Numerator of the Quotient. In like Manner, the Product of the Numerator of the Divisor, multiplied by the Denominator of the Dividend, will be the Denominator of the Quotient.

In the second Case, Every compound Fraction must be reduced to a simple one; and all the simple Fractions (both in the Dividend and Divisor) must be reduced to the same Denomination; then Multiply the Denominators of all the Fractions in the Divisor, and the Numerators of all the Fractions in the Dividend continually together for the Numerator of the Quotient. Also

Also Multiply the Numerators of all the Fractions in the Divisor, and the Denominators of all the Fractions in the Dividend, continually together for the Denominator of the Quotient.

If whole, or mixed Numbers occur, reduce them to improper Fractions, and proceed as above directed.

EXAMPLES.

Divide $\frac{19}{21}$ by $\frac{7}{8}$

$\frac{7}{8}\big)\frac{19}{21}\big(\frac{152}{147} = 1\frac{5}{147}$ the Quotient.

$8 \times 19 = 152$ New Numerator
$7 \times 21 = 147$ New Denominator

Divide $4\frac{1}{2}$ by 12.

$4\frac{1}{2} = \frac{9}{2}$, and $12 = \frac{12}{1}$

$\frac{12}{1}\big)\frac{9}{2}\big(\frac{9}{24} = \frac{3}{8}$ the Quotient

---

Divide $\frac{7}{8}$ $\frac{9}{10}$ $\frac{3}{4}$ by $\frac{2}{3}$ $\frac{1}{2}$

$\frac{2}{3}, \frac{1}{2}\big)\frac{7}{8}, \frac{9}{10}, \frac{3}{4}\big(\frac{1134}{640} = \frac{567}{320} = 1\frac{247}{320}$ Quot.

$3 \times 2 \times 7 \times 9 \times 3 = 1134$ N. Numerator
$2 \times 1 \times 8 \times 10 \times 4 = 640$ N. Denominator

Divide $\frac{7}{8}$ of 12£ by 11*s.* 6*d.*

$$\frac{7}{8}\times\frac{12}{1}=\frac{84}{8}=£\frac{21}{2} \text{ and } 11s.\ 6d. = £\frac{23}{40}$$

$$\frac{23}{40}\Big)\frac{21}{2}\Big(\frac{840}{46}=\frac{420}{23}=18\frac{6}{23}=18\,l.\ 5\,s.\ 2\tfrac{1}{2}\tfrac{10}{23}\,d.$$

DIVISOR, is that Number by which ſome other Number, Sum, or Quantity, is (or at leaſt underſtood to be) divided.

DOUBLE POSITION, ſo called becauſe it requires two Suppoſitions in order to obtain a true Anſwer to the Conditions propoſed.

The Rule is as follows.

Suppoſe a Number, or Quantity, at Pleaſure, and note it (as if granted) for the true Number, or Quantity ſought, and proceed therewith according to the Tenor of the Queſtion, as if you would prove the ſame; if the Reſult be leſs than the Quantity given, place the Defect oppoſite the ſuppoſed Number, and prefix the negative Sign to it. But if the Reſult be greater than the ſuppoſed Number, place it as above directed, and prefix the affirmative Sign to it. This done,

Suppoſe a ſecond Number, or Quantity, and place it under the firſt Error, and proceed in every Reſpect as with the former: Place the Error hence ariſing under the firſt ſuppoſed Number; Multiply the Errors, and Suppoſitions together, according to the Order

Order in which they stand; that is, the first supposed Number by the second Error, and the first Error by the second supposed Number; then if the Errors have like Signs, take the Difference of the Products for a Dividend, and the Difference of the Errors for a Divisor: The Quotient will be the Answer to the Question. But if the Signs are unlike, take the Sum of the Products for a Dividend, and the Sum of the Errors for a Divisor: The Quotient will be the Answer as above.

EXAMPLE.

A Man lying at the Point of Death, left to his three Sons his Estate in Money: to *A.* he gave the one Half, wanting 50*l.* to *B.* the one Third, and to *C.* the Rest, which was 10*l.* less than the Share of *B.* *Query*, The Sum left, and each Son's Share?

Suppose 1200 the Sum left, then

600	
50	
550 *A*'s Share	*Per* Conditions of the Question
490 *B*'s Share	
950 *A.* & *B*'s Share	
250 *C*'s Share	

But 150 is the Excess of *B*'s Share above *C*'s which should be only 10l. and therefore the Excess is too much by 140*l.* = the first Error.

Again,

Again, Suppose 600*l.* the Sum left, then,

250 *A*'s Share	}	*Per* Question.
200 *B*'s Share		
150 *C*'s Share		

But the Excess of *B*'s Share above that of *C.* is 50*l.* which should only be 10*l*, and is therefore too much by 40*l.* = the second Error.

1st Supposition	1200	2d Suppos.	600
2d Error	+40‡	1st Error	+140§
	48000*		84000
			48000*
	140§	†1|00)	360|00
	40‡		
	†100		360 the Sum left

And 130 *A*'s Share
120 *B*'s Share
110 *C*'s Share
As may be proved.

DOUBLE RULE of THREE, so called, because it requires two Statings, when performed by the single Rule of Three. It is known by having five Terms given; three in a Supposition and two in a Demand, to find a sixth; either in a direct, or in an inverse Proportion.

The

The general RULE is as follows.

I. *To State a Question.*

Let that Term in the Suppoſition, denoting the Thing which is the principal Cauſe of Loſs or Gain, Intereſt or Decreaſe, or that has Action or Paſſion, be put in the firſt Place; that which betokeneth Time, or Diſtance, and the Like, in the ſecond Place; and let the remaining Term poſſeſs the third Place.

Put the Terms in the Demand under their correſponding, or like, Terms of the Suppoſition; if the Blank falls under the third Term, the Proportion is Direct; But if it falls under the firſt or ſecond Term, the Proportion is Inverſe.

II. *To Work a Question.*

Reduce each Term of the Demand, and its correſponding Term of the Suppoſition, to one and the ſame Denomination; and the Term under which the Blank falls to the loweſt Denomination expreſſed therein; then if the Proportion be Direct; multiply the firſt and ſecond Terms together, and reſerve the Product for a Diviſor; alſo Multiply the three other Terms continually together, and reſerve the Product for a Dividend; the Quotient hence ariſing will be the Anſwer to the Queſtion in the ſame Denomination as the Term under which the Blank fell was reduced to. But if the Proportion be Inverſe; multiply the third and fourth Terms

together for a Divisor; and the other three for a Dividend: The Quotient will be the Answer as before.

EXAMPLES.

If 56 lb of Bread will be sufficient for 7 Men 14 Days; how much Bread will serve 21 Men 3 Days?

```
   M.   D.   lb     M.   D.
As 7 : 14 : 56 :: 21 : 3
   14              56
   --             ----
   98              126
   ==              105
                  ----
                  1176
                     3
                  ----
               98)3528(36 lb Answer
                  294
                  ----
                   588
                   588
                  ====
```

If 7 Men can reap 84 Acres of Wheat in 12 Days; how many Men can Reap 100 Acres in 5 Days?

M.

```
M.   D.   A.    D.   A.
7 : 12 : 84 :: 5 : 100
          5          7
        ---        ---
        420        700
        ===         12
                   ---
          42|0)840|0(20 Men Answer
               84
               --
               ..0
               ==
```

DRY MEASURE, is that which is used in measuring Corn, Salt, Coals, small Shell Fish, Sand, &c. The standard Bushel is a Cylindric Vessel, the Diameter of its Capacity being $18\frac{1}{2}$ Inches, and its Depth 8 Inches. *Vide* The Table.

Cub. In.	Pts.	Qts.	Pott.	Gal.	Pks.	Bsh.	qr.
$33\frac{3}{5}$	1	—	—	—	—	—	—
$67\frac{1}{5}$	2	1	—	—	—	—	—
$134\frac{2}{5}$	4	2	1	—	—	—	—
$268\frac{4}{5}$	8	4	2	1	—	—	—
$537\frac{3}{5}$	16	8	4	2	1	—	—
$2150\frac{2}{5}$	64	32	16	8	4	1	—
$17203\frac{1}{5}$	512	256	128	64	32	8	1

Note Also 2 Bushels make 1 Strike
2 Strikes —— 1 Sack or Coome
5 Bushels —— 1 Load
4 Quarters —— 1 Chaldron
5 Quarters —— 1 wey or cart load
2 Weys —— 1 Last.

N. B. Where Coals and Salt are meaſured by the Corn-Buſhel, they allow 4 heaped, or 5 ſtriked, Pecks to the Buſhel (commonly called Water Meaſure) and

3 of ſuch Buſhels	make	1 Sack	of Coals
3 Sacks	———	1 Vatt	
4 Vatts	———	1 Chaldron	
21 Chaldron	———	1 Score	

DUODECIMALS, are Fractions whoſe Numerators only are expreſſed; the Denominator of each being always underſtood to be 12.

DUPLICATE PROPORTION, is that which is compounded of two Proportions that are ſimilar to each other.

DUPLICATE RATIO, is that of the Squares of any two Numbers or Quantities.

DUPLICATION, a doubling, or multiplying, by 2.

DYADIC ARITHMETIC, the ſame as Binary Arithmetic.

E

ELECTION of NUMBERS, is the different Ways which they may be taken without having Respect to their Places.

ENNEAD, the Number of Nine.

ENUMERATION, a Numbering or Summing up.

EPACT, is a Number expressing the Excess of the Solar Year above the Lunar Year; *viz.* The Moons Age on the first Day of *January*; and is thus found.

RULE. From the Golden Number subtract an Unit; reserve the Difference; also divide the said Difference by 3, and multiply the Remainder (not the Quotient) by 10, and to the Product add the Difference before reserved; the Sum, if less than 30, is the Epact; but if it exceeds 30, the Excess is the Epact.

EXAMPLE.

What is the Epact of this present Year 1772?

6 = the Golden Number
1
———
3)5*(1
3
———
2
10
———
20
5*
———
Anſwer 25 the Epact required.

EQUATION is a mutual comparing of Things, of different Denominations, with reſpect to Equality.

EQUATION of PAYMENTS, is when ſeveral Sums due at different Times are required to be paid all together, or at once; and at ſuch a certain Time as neither Debtor, nor Creditor, may ſuſtain Loſs thereby. The common Method of finding the equated Time is as follows.

RULE. Reduce the ſeveral Sums to one and the ſame Denomination; alſo reduce the Times of Payment to one and the ſame Name: Multiply the reduced Sums, each by its reſpective reduced Time of Payment, and divide the Sum of the Products by the Aggregate or Total, of the reduced Sums: The Quotient will be the Time of Payment required, in the ſame Denomination as the Times were reduced to.

EX-

EXAMPLE.

A. owes *B.* the following Sums, *viz.* 40*l.* payable at 3 Months; 60*l.* at 6 Months; and 100*l.* at nine Months: *Query*, At what Time the Whole may be paid together, without Loſs to either Party, with reſpect to Intereſt?

```
 £.     M.
 40  ×  3  =  120
 60  ×  6  =  360
100  ×  9  =  900
----       ------
*200    *2|00)13|80(
              ----
           M. 6|180
                 30
              ------
          *2|00)54|00(
                ----
              D. 27
                ====
```

	M.	D.
Anſwer	~~7~~ 6	27

N. B. Notwithſtanding the foregoing Method is quite ſufficient in common Occurrences; yet where great Exactneſs is required, and the out-ſtanding Debts bear Intereſt; the following Rule becomes neceſſary, *viz.*

Find the preſent worth of each Sum or Payment, according to its reſpective Time and Rate per Cent. (per Caſe I. of Rebate or Diſcount) add all the preſent Worths together,

gether, and find the Time in which their Total would amount to the Total, or Aggrugate, of all the given Sums or Payments. (per Case IV. of Rebate or Discount) The Time so found will be the equated Time required.

EQUIMULTIPLES, are such as are multiplied by one, and the same Number. Or which contain their Submultiples an equal Number of Time.

ESCHAUNCE, exchange.

EVEN NUMBER, is such as may be divided into two equal Parts without leaving a Fraction.

EVENLY EVEN NUMBER, is such as may be divided by another even Number, without leaving a Remainder.

EVENLY ODD NUMBER, is such an even Number as may be divided by an odd one, without leaving a Remainder.

EVOLUTION, is the Extraction of Roots.

EXCHANGE. Truck or Barter; also a Rule which teaches to find how much Money of one Country is equal to any proposed Sum in the current Money of another Country; and is only an Application of the single Rule of Three.

EXAMPLES.

What Money, English Currency, is equal to 876 Pieces of Eight, of Cadiz. *(Vide Money)*

P. E.

P. E. d. P. E.
1 : 54 :: 876
54

3504
4380

12)47304

2|0)394|2

£197 2 Answer

How many Pieces of Eight of *Cadiz* are equal to 197*l.* 2*s.* English Currency.

d. P. E. £ *s.*
54 .. 1 :: 197 2
20

3942
12

P. E.
54)47304(876 Answer
432

410
378

324
324

EXPONENT, a Number expressing the Power of any Root.

EX-

EXPONENT of a RATIO, or PROPORTION, is the Quotient arising from dividing the Antecedent by the Consequent.

EXTRACTION of ROOTS, is a Method of finding the Root of any Power; the general RULE for which is as follows.

Divide the given Number into Periods of as many Places each, as are equal to the Exponent of the Power of the Root; accounting from the left Hand towards the right.

Find the greatest integral Root (of the same Name with the required) that is contained in the first Period towards the left Hand,* and put it in the Quotient.

Raise the Quotient to a Power equal to that which is given; which Power subtract from the Period taken in the given Number, and to the Difference annex the Figure possessing the first Place of the next occurring Period for a Resolvend.

Raise the Quotient to the next inferior Power to that which is given; which Power multiply by the Exponent of the given Power; and reserve the Product for a Divisor.

Find how often the Divisor is contained in the Resolvend, and put the Figure expressing the Times in the Quotient.

Raise the Quotient to a Power equal to that which is given; which Power subtract from the Periods taken in the given Number; and to the Difference annex the first Figure

* *Vide Table of Powers.*

Figure of the next succeeding Period, for a new Resolvend.

Find a new Divisor as before taught, and repeat the Process until the Whole be finished: The Quotient will be the Root required.

N. B. If there be a decimal Fraction at the End of the given Number, such Fraction must be made to consist of entire Periods, by annexing Cyphers to it. There must also be as many Places pointed off toward the right Hand of the Quotient for a Decimal, as there are Periods in the decimal Places given.

EXAMPLE.

What is the Cube Root of 99252847?

$\sqrt[3]{99'252'847}$ = 463 Answer

4×4×4=64

4×4×3=48)352

46×46×46=97336

46×46×3=6348)19168

463×463×463=99252847

....

Notwithstanding the foregoing Rule is applicable in all Cases, it may not be improper to insert the following particular ones.

EXTRACTION of the BIQUADRATE ROOT.

RULE. Extract the square Root of the given Number; from which Root also, extract the square Root: The last Root will be that required.

EXAMPLE.

What is the Biquadrate Root of 5719140625?

```
 2
 √ 57'19'14'06'25) = 75625.
   49
   ---
145)819
    725
    ---
1506)9414
     9036
     ----
15122)37806
      30244
      -----
151245)756225
       756225
       ======
```

```
        2
Again   √ 7'56'25.) = 275 Answer.
          4
          ---
       47)356
          329
          ---
      545)2725
          2725
          ====
```

Hence $\sqrt[3]{5719140625} = 275$

EXTRACTION of the CUBE ROOT of a DECIMAL FRACTION, is performed in every respect the same as that of an integral Number; only Note,

I. The given Fraction must be made to consist of whole or entire Periods of three Places each, by annexing Cyphers to it.

II. The Number of such Periods must be made equal to the Number of Figures, or Places, required in the Root.

III. If the first Period towards the left Hand consists entirely of Cyphers, put a Cypher in the Quotient, and proceed to the next Period; if that consists of Cyphers likewise, put another Cypher in the Quotient, and so on, until you come to the significant Figures with which proceed as in whole Numbers.

IV. The Root will be a decimal Fraction.

EXAMPLE.

What is the Cube Root of ,000000125?

$\sqrt[3]{,000'000'125} = ,005$ Answer

125

Q 2 What

What is the Cube-Root of ,03 to two Places?

$$\sqrt[3]{,030'000} = ,31 \text{ Answer}$$

	27
3×3×300=2700)	3000 Resolvend
1×1×1=	1
1×1×3×30=	90
2700×1=	2700
	2791 Subtrahend
	209

EXTRACTION of the CUBE ROOT of an INTEGRAL NUMBER.

RULE. Divide the given Number into Periods of three Places each, accounting from the right Hand towards the left.

Find the greatest cubic Number contained in the first Period towards the left Hand, and subtract it therefrom; also put its Root in the Quotient; then annex the Figures of the next occurring Period to the Difference arising from the above-mentioned Subtraction for a Resolvend.

Multiply the Square of the Quotient by 300, and reserve the Product for a Divisor.

Find how often the Divisor is contained in the Resolvend, and put the Figure expressing the Times in the Quotient.

Raise

Raiſe the Figure laſt put in the Quotient to the Power of a Cube, and reſerve it. Alſo multiply the Square of the Figure laſt put in the Quotient, by all the foregoing Figures of the ſaid Quotient, and multiply the Product hence ariſing by 30. Place this laſt Product under the cubic Number before reſerved, as in Addition; and reſerve it alſo. Likewiſe multiply the Diviſor, by the Figure laſt put in the Quotient, and to the Product add the Numbers before reſerved; the Sum will be the Subtrahend, which ſubtract from the Reſolvend, and to the Difference annex the Figures of the next occurring Period for a new Reſolvend; with which proceed in every Reſpect as above, until the Whole is finiſhed: The Quotient will be the Cube Root required.

N. B. When a decimal Fraction occurs in the given Number, it muſt be made to conſiſt of entire Periods; *viz.* of 3, 6, 9, 12, *&c.* Places by annexing Cyphers to it, and as many Places muſt be pointed off from the right Hand of the Quotient, for a Decimal, as are equal to the Number of Periods in the Decimal given.

EX-

EXAMPLE.

What is the Cube Root of 99252847 ?

$\sqrt[3]{99'252'847} = 463$ Answer

```
                     64
                   -------
4×4×300 = 4800)35252 Resolvend
                   -------
     6×6×6 =        216
   6×6×4×30 =      4320
    4800×6 =      28800
                   -------
                  33336 Subtrahend
                   -------
46×46×300=634800)1916847 Resolvend
                   -------
       3×3×3 =          27
   3×3×46×30 =       12420
    634800×3 =     1904400
                   -------
                   1916847 Subtrahend
                   -------
                   .......
```

N. B. The following is a new Rule for the Extraction of the Cube Root; produced by taking two Terms of an approximating Series.

RULE. Having divided the given Number into Periods, and found the Root of the first Period, as in the foregoing Rule; increase the said Root by annexing as many Cyphers

Cyphers to it as there are remaining Periods in the Number given.

Multiply the increased Root by 3, and with the Product divide the given Number; reserve the Quotient.

Divide the Square of the increased Root by 12, and subtract the Quotient from the Quotient before reserved; extract the square Root of the Difference, to which Root add half the increased Root: The Sum will be the Cube Root required.

N. B. The Remainders in every Part of the Process may be rejected.

When the Root of the first Period is an Unit, annex the integral Half of the first Figure in the next occurring Period to it, with as many Cyphers as there are remaining Periods; and proceed in every Respect as before.

When the given Number is a Surd, it must be made to consist of as many decimal Periods (by annexing Cyphers to it) as there are decimal Places required in the Root.

EX-

EXAMPLE.

What is the Cube Root of 99252847?

$400^2 \times 3 = 12|00)99'242'8|47($

82710

$\frac{400^2}{12} =$ 13333

√6'93'77(=263 $\frac{400}{2}$

4 200 =

46)293 463 Answer

276

523)1777

1569

208

EXTRACTION of the SQUARE ROOT of a DECIMAL FRACTION, is the same as that of an Integral Number; only Note,

I. The given Decimal must be made to consist of an even Number of Places (by annexing Cyphers to it) and of as many Periods, of two Places each, as are equal to the proposed Number of Places in the Root.

II. If the first Period towards the left Hand consists entirely of Cyphers, put a Cypher in the Quotient, and proceed to the second Period; if that consists of Cyphers likewise, put another Cypher in the Quotient, and so on, until you come to the significant

significant Figures; with which proceed as in whole Numbers.

III. The Root will be a decimal Fraction.

EXAMPLES.

What is the Square Root of ,106929?

```
√,10'69'29 = ,327 Answer
  9
 ---
62)169
   124
   ---
647)4529
    4529
    ----
```

What is the Square Root of ,00008836?

```
√,00'00'88'36 = ,0094 Answer
       81
      ---
  184)736
      736
      ---
```

EXTRACTION of the SQUARE ROOT of an INTEGRAL NUMBER.

RULE. Divide the given Number into Periods of two Places each, accounting from the right Hand toward the left.

Find the greatest integral Square Number contained in the first Period towards the left

left Hand, and subtract it therefrom; also put its Root in the Quotient, and to the Difference arising from the above-mentioned Subtraction, annex the Figures of the next occurring Period for a Resolvend.

Double the Quotient for a Divisor; find how often the Divisor is contained in the Resolvend (reserving the Unit's Place) and put the Figure expressing the Times in the Quotient, and also annex it to the Divisor.

Multiply the Divisor (after it hath been so increased) by the Figure last put in the Quotient; the Product will be the Subtrahend.

Subtract the Subtrahend from the Resolvend, and to the Difference annex the Figures of the next occurring Period; and repeat the Process as above directed till the Whole is finished: The Quotient will be the Root required.

N. B. If there be a decimal Fraction annexed to the given Number, it must be made to consist of an even Number of Places (by annexing Cyphers to it) and there must be as many Places pointed off towards the right Hand of the Quotient, for a Decimal, as there are Periods in the fractional Part of the Number given.

EX-

EXAMPLE.

What is the Square Root of 22,071204?

$\sqrt{22,'07'12'04} = 4,698$ Answer

```
  16
  ----
86)607
   516
   ----
929)9112
    8361
    -----
9388)75104
     75104
     -----
```

EXTRACTION of the ROOT of a VULGAR FRACTION.

RULE. Reduce the given Fraction to its lowest Terms, and extract the Root of the Numerator and Denominator, according to the Rules already laid down; such Roots will constitute a Fraction expressing the Root required.

If the given Fraction be a Surd reduce it to a Decimal, or if a mixed Number occur, reduce the fractional Part to a Decimal, which annex to the whole Number, and proceed as before directed.

EXAMPLE.

What is the Cube Root of $\frac{250}{686}$?

First. $\frac{250}{686} = \frac{125}{343}$, and $\sqrt[3]{\frac{125}{343}} = \frac{5}{7}$ Answer

EXTREAM (in arithmetical or geometrical Progressionals) is the least and the greatest Term.

F

FACT (in Multiplication) is the Product or Rectangle.

FACTORAGE, is an Allowance (commonly from 2*l.* to 5*l.* per Cent.) made by the Merchant to his Factor, upon the Amount of Goods bought or sold, on his Account.

The Factorage due upon any Sum may be found by the following Rule.

Multiply the given Sum by the Rate per Cent. and divide the Product by 100: The Quotient will be the Factorage required.

EXAMPLE.

Suppose a Factor sells Goods on my Account, to the Amount of 754*l.* 16*s.* what may he Demand upon his Commission, when I allow him $2\frac{1}{2}$*l.* per Cent.

£.

	£	s.
$\frac{1}{2}$	754	16
		2
	1509	12
	377	8
£	18|87	0
		20
s.	17|40	
		12
d.	4|80	
		4
qrs.	3|20	

£ 18 s. 17 d. $4\frac{3}{4}$ Answer

N. B. Questions of this Kind may be aptly wrought by Practice.

Let us suppose the foregoing Example,

£	s.		£	s.
		$\frac{1}{5}$	754	16
2	10	$\frac{1}{8}$	150	19. $2\frac{1}{4}$

£ 18 17 $4\frac{3}{4}$ Answer

FACTORS (in Multiplication) are the Multiplicand and Multiplier.

FELLOWSHIP, is a Rule whereby the Loss or Gain of every Individual of a joined Company

pany is estimated, in Proportion to the Part he contributes or possesses of the common Stock: Also by this Rule the Estate of a Bankrupt may be divided amongst his Creditors, and Legacies adjusted when there is a deficiency of Assets or Effects.

FELLOWSHIP *without* TIME, is when the Partners continue their assigned Parts of Stock unalterable for one and the same Time.

RULE. As the intire Stock is to the whole Gain or Loss, so is each Person's Part of Stock to his particular Share of the Gain or Loss.

EXAMPLE.

A, *B*, and *C*. traded together; *A* advanced 750*l*. *B* 460*l*. and *C* 500*l*. they gained 184*l*. What was each Person's Share thereof?

		£.
A's Part of Stock	=	750
B's ditto	=	460
C's ditto	=	500
Entire Stock	=	1710

As

£ £ £
As 1710 : 684 :: 750
684

3000
3420
4788

171|0)51300|0(300*l.* = *A*'s Share of Gain.
513

00

£ £ £
As 1710 : 684 :: 460
460

4104
2736

171|0)31464|0(184*l.* = *B*'s Share of Gain.
171

1436
1368

684
684

As

£ £ £
As 1710 : 684 :: 500
500

1710)342000(200*l.* = *C*'s Share of Gain.
342

.00

FELLOWSHIP *with* TIME, is when the distinct Parts of Stock belonging to the several Partners are fluctuating, and the Time of their Continuance in Trade unequal.

RULE. Reduce every Person's Part of Stock to the same Denomination, and multiply each by the respective Time it has continued in Trade; add the Products together: Then as the Sum of the Products is to the whole Gain or Loss, so is each of the Products severally to the particular Share of the Gain or Loss of every Person respectively.

EXAMPLE.

A, *B*, and *C*, traded together; *A* advanced 450*l.* *B* 210*l.* *C* 300*l.* at the End of 3 Months, *B* advanced 100*l.* more; one Month after *A* withdrew his whole Stock, and at the End of 6 Months the Partnership disolved; at which Time their Gain was 250*l.* *Query*, Each Person's Share thereof.

A's

	£	M.			£
A's Stock	450	× 4	=	- - -	1800
B's 1st ditto	210	× 3	=	630	1560
B's 2d ditto	310	× 3	=	930	
C's Stock	300	× 6	=	- - -	1830
				Total	5160

£
As 5160 : 250 :: 1800
1800

200
25

516|0)45000|0(87 4 $2\frac{120}{516}$ = A's Gain

(£. s. d.)

4128

3720
3612

108
20

516)2160
2064

96
12

516)1152
1032

120

£
As 5160 : 250 :: 1560
250
780
312
£ s. d.
516|0)39000|0(75 11 7 $\frac{276}{516}$ *B*'s Gain
3612
2880
2580
300
20
516)6000
516
840
516
324
12
516)3888
3612
276

£ £ s. d.
As 5160 : 250 :: 1800 : 87 4 2 $\frac{\cdots}{516}$ *G*'s Gain

PROOF.

PROOF.

	£	s.	d.
A's Gain	87	4	2 . 120
B's ditto	75	11	7 . 276
C's ditto	87	4	2 . 120
Total	250	0	0 as given

FIGURATE NUMBERS, are ſuch as repreſent geometrical Figures.

FIGURE, one of the nine Digits or Characters, 1, 2, 3, 4, 5, 6, 7, 8, 9.

FLUXIONARY ARITHMETIC, a Species of Arithmetic of Infinites.

FRACTION, a Part of an Unit or of the Whole.

FRACTIONAL ARITHMETIC, is that which treats of Fractions.

FRACTIONAL NUMBERS, are ſuch as conſiſt of Fractions.

G

GEODÆTICAL NUMBERS, are ſuch as are conſidered according to the vulgar Names or Denominations, by which Money, Weights, Meaſures, &c. are generally known, or particularly divided, by the Laws and Cuſtoms of Nations.

GEOMETRICAL MEAN, between any two Numbers, is the ſquare Root of the Product of their Multiplication into each other.

GEOMETRICAL PROGRESSION, is when, in a

a Rank or Series of Terms, the Numbers increase or decrease by a successive Multiplication or Division of the same common Multiplier or Divisor. It admits of eight Cases, which are as follow.

CASE I.

The least Extream, Ratio, and Number of Terms being given, to find the greatest Extream.

RULE. Raise the Ratio to a Power whose Exponent is one less than the Number of Terms, and multiply the Power so raised by the least Extream; The Product will be the greatest Extream.

N. B. If a Series of Terms in arithmetical Progression, whose least Extream and common Difference are unity, be produced until the Number of Terms is equal to the Exponent of the afore-mentioned Power, they will be the Indices of all the intermediate Powers of the Ratio; and if any two or more of such Indices be added together, their Sum will be the Indice of that Power which would be produced from multiplying together the Powers corresponding with those Indices which were added together.

EXAMPLE.

Suppose a Farmer sows five Bushels of Corn the first Year; and makes the Produce thereof the Seed of the second Year, and the Produce of the second Year the Seed of the third

third, &c. for 9 Years: *Query*, How many Bushels he sowed the last Year, allowing the yearly increase to be three fold.

Indices	1, 2, 3, 4, 5, 6, 7, 8.
Powers	3, 9, 81 6561.

Indices	1 + 1 = 2	2 + 2 = 4	4 + 4 = 8
Powers	3 × 3 = 9	9 × 9 = 81	81 × 81 = 6561

therefore 6561 × 5 = 32805 Bush. Answer.

CASE II.

The greatest Extream, Number of Terms and Ratio, being given; to find the least Extream.

RULE. Raise the Ratio to a Power whose Exponent is one less than the Number of Terms, and with the said Power divide the greatest Extream: The Quotient will be the least Extream.

EXAMPLE.

There are 9 Terms in Geometrical Progression, their Ratio is 3, and the greatest Extream is 32805: *Query*, The least Extream.

Ind.	1 + 1 = 2	2 + 2 = 4	4 + 4 = 8
Pow.	3 × 3 = 9	9 × 9 = 81	81 × 81 = 6561

6561)32805(5 Answer.
32805

CASE

CASE III.

The Extreams and Number of Terms being given; to find the Ratio.

RULE. Divide the greater Extream by the less, the Quotient will be a Power of the Ratio whose Exponent is one less than the Number of Terms; therefore extract the Root of the Quotient accordingly; which Root will be the Ratio required.

EXAMPLE.

There are 9 Terms in Geometrical Progression; the greater Extream is 32805, and the less 5; *Query*, The Ratio.

5)32805(

$\sqrt[8]{6561}$ (=3 Answer

3×3×3×3×3×3×3×3 = 6561

CASE IV.

The Extreams and Ratio being given; to find the Number of Terms.

RULE. Divide the greater Extream by the less, and the successive Quotients continually by the Ratio, until the last Quotient is an Unit, and the Remainder (0) the Number of all those Divisions, will be equal to the Number of Terms required.

EX-

EXAMPLE.

In a Series geometrical Progressionals, the greater is Extream 32805, the less 5, and the Ratio 3: *Query*, The Number of Terms.

1 - - 5)32805(

2 - - 3)6561(

3 - - 3)2187(

4 - - - 3)729(

5 - - - 3)243(

6 - - - - 3)81(

7 - - - 3)27(

8 - - - - 3)9(

9 - - - - 3)3(

1

Answer, 9 equal to the Number of Divisions.

CASE V.

The Extreams and Ratio being given; to find the Sum of all the Terms.

RULE. From the Rectangle of the greatest Extream into the Ratio, subtract the least Extream; reserve the Difference; also from the

the Ratio subtract an Unit, and with the Difference so found divide the Difference before reserved; The Quotient will be equal to the Sum of all the Terms.

EXAMPLE.

In a Series of geometrical Progressionals, the greater Extream is 32805, the less 5, and the Ratio 3: *Query*, The Sum of all the Terms.

```
 32805        3
     3        1
 -----       --
 98415        2
     5       ==
 -----
2)98410
 -----
 49205 Answer
```

CASE VI.

The Extreams and Sum of all the Terms being given, to find the Ratio.

RULE. From the Sum of all the Terms subtract the least Extream; reserve the Difference; also from the said Sum subtract the greatest Extream, and with the Difference so found divide the Difference before reserved: The Quotient will be equal to the Ratio.

EX-

EXAMPLE.

In a Series of geometrical Progressionals, the greater Extream is 32805, the less 5, and the Sum of all the Terms 49205: *Query*, The Ratio.

49205	49205
5	32805
•164|00)492|00(Answer	16400•
492	

CASE VII.

The greater Extream, Ratio and Sum of all the Terms being given; to find the least Extream.

RULE. To the Sum of all the Terms add the Rectangle of the greatest Extream into the Ratio, and from the Total subtract the Rectangle of the Sum of all the Terms into the Ratio: The Difference will be equal to the least Extream.

EXAMPLE.

In a Series of geometrical Progressionals, the greatest Extream is 32805; the Ratio 3, and the Sum of all the Terms 49205; *Query*, The least Extream?

32805	49205
3	3
98415	147615
49205	
147620	
147615*	
5 Answer	

CASE VIII.

The least Extream, Ratio, and Sum of all the Terms being given; to find the greatest Extream.

RULE. To the Rectangle of the Sum of all the Terms into the Ratio add the least Extream, and from the Total subtract the Sum of all the Terms; divide the Difference by the Ratio; The Quotient will be equal to the greatest Extream.

EXAMPLE.

In a Series of geometrical Progressionals, the least Extream is 5, the Ratio 3, and the Sum of all the Terms 49205; *Query*, The greatest Extream?

49205

```
     49205
         3
   -------
    147615
         5
   -------
    147620
     49205
   -------
 3) 98415
   -------
    32805 Anfwer
```

GEOMETRICAL PROPORTION, is when of three Terms, the Product of the Extreams is equal to the Square of the Mean; or of four Terms, when the Product of the Extreams is equal to that of the Means.

GOLDEN NUMBER, is that which expreffes what Year of the Lunar Cycle any Year is of; and is thus found.

RULE. To the Year of our Lord add one and divide the Sum by 19; The Remainder (not the Quotient) will be the Golden Number.

N. B. If the Remainder be (o) the Golden Number is 19.

EXAMPLE.

What is the Golden Number of this prefent Year 1772?

 1772

1772
1

19)1773(93
171

63
57

6 Answer

GOLDEN RULE, the Rule of Three.

GROSS WEIGHT, is the whole Weight of the Barrel, Bag, Box, Wrapper, &c. together with the Commodity it contains, before any Deduction is made.

H

HARMONICAL MEAN, (between any two Numbers) is the Quotient arising from dividing the doubled Product of the two Numbers into each other, by their Sum.

HARMONICAL PROPORTION, is when of three Terms, the Difference of the first and second is to the Difference of the second and third, as the first is to the third: Or of four Terms, when the first is to the fourth, as the Difference of the first and second to the Difference of the third and fourth.

CASE

C A S E I.

Two Numbers being given; to find a third in Harmonical Proportion.

Rule. Suppose one of them to be the first Term, and the other the second; multiply the two Terms together; reserve the Product; then from double the first Term subtract the second, and by the Difference so found divide the Product before reserved: The Quotient will be the third Proportional sought.

EXAMPLE.

Query, A third Term in Harmonical Proportion to 3 and 4?

$3 \times 4 = 12$ $2)12($

$\overline{3\times 2 - 4} = 2$ 6 Answer

C A S E II.

Three Numbers being given; to find a fourth in Harmonical Proportion.

Rule. Multiply the first Term by the third; reserve the Product; then from double the first Term subtract the second, and with the Difference so found divide the Product before reserved: The Quotient will be the fourth Proportional sought.

EXAMPLE.

Query, A fourth Term in Harmonical Proportion to 9 : 12 and 16?

9×16

$9 \times 16 = 144$ ‡6)144(

$\overline{9 \times 2}^2 - 12 = 6‡$ 24 Answer

HEBDOMADE, the Number of Seven.

HETEROGENEAL NUMBERS, are such as have their Units referred to different Integers.

HETEROGENEAL SURDS, are such as have different radical Signs.

HOMOGENEAL NUMBERS, are those of the same Kind and Nature; such as have their Units referred to the same Integer.

HOMOGENEAL SURDS, are such as have the same radical Sign.

I

IMPERFECT NUMBERS, are such whose Sums of their aliquot Parts are not equal to the Numbers themselves.

IMPROPER FRACTIONS, are such as have their Numerators greater, or at least equal to their Denominators.

INCOMMENSURABLE NUMBERS, are such as have no common Divisor.

INCOMPOSITE NUMBERS, are the same as prime Numbers.

INDEX, a Figure prefixed to a Logarithm, in order to determine how many Places the absolute Number belonging thereto consists of.

IN-

INDICES, Numbers in arithmetical Progression placed over the Terms in geometrical Progression, in order to shew their Power and Place.

INORDINATE PROPORTION, is when the Order of the Terms is disturbed.

INSTRUMENTAL ARITHMETIC, is that which is mechanically performed, as by the Sector, plain Scale, Nepeirs, Bones, &c.

INTEGERS, entire Units, whole Numbers; not Fractions.

INTEGRAL, of or belonging to an Integer, whole, entire.

INTEREST, a Sum paid in Consideration of the Forbearance or Loan of Money, by the Borrower to the Lender, at a certain Rate per Cent. per Annum.

INVERSE PROPORTION, (in the Rule of Three) is when the fourth Term has the same Ratio to the second, as the first Term has to the third. Or (in the double Rule of three) when the sixth Term has the same Proportion to the fourth and fifth, as the first has to the second and third; or as the second has to the first and third.

N. B. The Proportion is known to be Inverse, when more requires less; that is, when the Third Term is greater than the first, and the fourth Term is required to be less than the second.

Also less requiring more, denotes the Proportion to be Inverse; that is when the third Term is less than the first, and the fourth

fourth Term is required to be greater than the second.

IRRATIONAL NUMBERS, the same as surd Numbers.

JUST DIVISORS, are such Numbers as will divide a given Number without leaving a Remainder.

N. B. All the just Divisors of any Number may be thus found,

RULE. If the given Number is even divide it, and the successive Quotients continually by 2, so long as the Division will last, without leaving a Remainder; reserve all the Divisors: But if either the given Number or the Quotient arising from the Division by 2, be odd, divide it and the successive Quotients by 3, in like Manner as before taught: Likewise, when the Division by 3 ceaseth, divide by 5, 7, 11, 13, 17, 19, 23, &c. that is, by every prime Number, until the Quotient is less than the Divisor; place several prime Divisors alternately at the Head of separate Columns: Multiply the Number in the first Column by that in the second Column, and place the Product under its Multiplier, *viz.* in the second Column, then multiply all the Numbers in the first and second Columns by that in the third, and place the Products under the Multiplier; that is, in the third Column. Proceed thus thro' all the Columns, and the several Products so produced will be just Divisors to the Number given.

If a Product happens to be the same as any

any other before produced, it must be omitted, and not inserted in any of the Columns.

EXAMPLE.

Query, All the just Divisors of 360?

2)360
2)180
2)90
3)45
3)15
5)5
1

2	2	2	3	3	5
	4	8	6	9	10
			12	18	20
			24	36	40
				72	15
					30
					60
					120
					45
					90
					180
					360

Hence all the just Divisors of 360, as collected in the foregoing Table are 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, 36, 40, 45, 72, 90, 180, 360. But it must be observed that 1 is not properly a Divisor, altho' it be an aliquot Part.

L

LAND MEASURE, is chiefly used by Land-Surveyors, in laying out and estimating the Quantity of any Parcel or Parcels of Grounds or Estates. *Vide the Table.*

Sq: Links	Perches	Chains	Roods	Acres
625	1	—	—	—
10000	16	1	—	—
25000	40	$2\frac{1}{2}$	1	—
100000	160	10	4	1

LIQUID MEASURE, see Beer, Ale, and Wine Measure.

LITTERAL ARITHMETIC, is the same as specious Arithmetic, which see.

LOGARITHMS, are the Indices of the Ratios of Numbers one to another; or a Series of artificial Numbers, proceeding in arithmetical Proportion, corresponding to as many others proceeding in geometrical Proportion; contrived for the easing and expediting Calculation.

LOGISTICAL ARITHMETIC, a Denomination sometimes given to the Arithmetic of Sexagesimal Fractions, chiefly used by Astronomers in their Calculations.

LOGISTICAL LOGARITHMS, are such as are fitted to sexagesimal Fractions. *Vide Shakerly's Tabulæ Britannicæ.*

LONG

LONG MEASURE, is used where Length only is considered, no regard being had to Breadth nor Thickness.

B. C.	Inches	Hands.	Feet	Yds.	Pol.	Fur	M.
3	1	—	—	—	—	—	—
12	4	1	—	—	—	—	—
36	12	3	1	—	—	—	—
108	36	9	3	1	—	—	—
594	198	49½	16½	5½	1	—	—
23760	7920	1980	660	220	40	1	—
190080	63360	15840	5280	1760	320	8	1

A L S O

Inches	Links.	Poles	Chains	Furls.	Miles.
7. 92	1	—	—	—	—
198	25	1	—	—	—
792	100	4	1	—	—
7920	1000	40	10	1	—
63360	8000	320	80	8	1

A G A I N,

5 Feet } make { 1 Geometrical Pace,
6 Feet } make { 1 Fathom.
3 Miles } make { 1 League.
69½ Miles } make { 1 Degree of a great Circle upon the Earth.

MAGIC SQUARE, is when ſeveral Numbers in an arithmetical Proportion are diſpoſed into ſuch parrallel and equal Ranks, that the Sums of each Row taken any Way either perpendicularly, horizontally or diagonally, ſhall be all equal; as in the following Square.

16	14	8	2	25
3	22	20	11	9
15	6	4	23	17
24	18	12	10	1
7	5	21	19	13

N. B. Thoſe that would know the Nature and Method of conſtructing ſuch Squares, may conſult *M. Frenicle* and *M. De la Hire*, upon the Subject.

MEAN PROPORTIONAL, ſee arithmetical, geometrical and harmonical Mean.

MEDIATION, a dividing by 2.

MINUEND, the Number, Sum, or Quantity, from which the Subtrahend is to be ſubtracted.

MIXED NUMBERS, are ſuch as have Fractions annexed to them.

MIXED FRACTIONS, are ſuch that have mixed Numbers for either or both their Numerators and Denominators.

MIXED PROPORTION, is when the Sum of the

the Antecedent and Consequent is compared with the Difference between the same Antecedent and Consequent.

MONADES, the same as Digits.

MULTIPLE, one Number is said to be the Multiple of another, when it contains it a certain Number of Times.

MULTIPLE PROPORTION, is when the Antecedent being divided by the Consequent, the Quotient is greater than Unity.

MULTIPLICAND, the Number, Sum or Quantity to be multiplied.

MULTIPLICATION, is a compendious Way of performing many repeated Additions of the same Number, Sum or Quantity.

MULTIPLICATION of DECIMALS, is performed in the same manner as that of Integers, only Note,

I. That there must be as many Places pointed off towards the right Hand of the Product for a Decimal, as there are decimal Places in both the given Factors taken together.

II. If the Product does not consist of as many Places as there are decimal Places in both Factors taken together, the Defect must be supplied by prefixing as many Cyphers to it as will make the Places equivalent.

EX.

EXAMPLES.

Multiply	4,63	4,63
By	12,3	12,3
		1389
		5556
	Product	56,949

Multiply	,6942
By	,25
	34710
	13884
Product	,173550

Multiply	,076
By	,03
Product	,00228

MULTIPLICATION of INTEGERS, is the multiplying of one whole Number by another; and is thus performed:

RULE. Place the Factors the one under the another, as in Addition; draw a Line under the same; then multiply the Multiplicand by

by every Figure ſeverally of the Multiplier, *viz.* multiply the Figure in the Unit's Place of the Multiplicand by the Figure in the ſame Place of the Multiplier, and let the Figure poſſeſſing the Unit's Place of the Product be ſet under its own Denomination below the Line, and the remaining Figure or Figures (if any) added to the Product of the next occurring Figure of the Multiplicand. Set the Figure in the Unit's Place of the Sum hence ariſing, exactly under the Figure of the Multiplicand; that is, immediately under Operation; and add the remaining Figure or Figures to the Product of the next occurring Figure of the Multiplicand. Proceed in this Manner to the laſt Figure of the Multiplicand, which being multiplied, and what was carried added to the Product, the whole Sum muſt be ſet down. This done, Repeat, in every reſpect, the foregoing Proceſs with the next occurring Figure of the Multiplier: *viz.* Multiply the Multiplicand by the Figure in the Ten's Place of the Multiplier, and put the Product under the Former in ſuch a Manner that the firſt Figure thereof may ſtand exactly under its reſpective Multiplier. Continue the Proceſs with every Figure of the Multiplier; and when finiſhed, add the ſeveral Products together: Their Sum will be the total Product.

N. B. Multiplication and Diviſion prove each other.

Alſo Note, That if the Factors are affected

fected with Signs, and they both Affirmative or both Negative, the Product will be an affirmative Number. But if they have unlike Signs; that is, the one Affirmative and the other Negative, the Product will be a Negative Number.

EXAMPLES.

Multiply	4609627
By	4568
	36877016
	27657762
	23048135
	18438508
Product.	21056776136

Multiply	— 2760940
By	— 3069
	2484846
	1656564
	828282
Product	+ 8473324860

Multiply

Multiply	− 360207
By	+ 64
	1440828
	2161242
Product	− 23053248

N. B. Had the Multiplier been Negative and the Multiplicand Affirmative, the Product would then have been a negative Number as above.

Notwithstanding the foregoing Rule is general, it may not be improper to insert the following particular Cases.

CASE I.

When Cyphers are placed between the significant Figures of the Multiplier.

RULE. Omit the Cyphers in the Operation, and let the first Figure of each distinct Product stand exactly under its Multiplier; add the Products together: Their Sum will be the total Product.

EXAMPLE.

Multiply	462760046
By	30006
	2776560276
	1388280138
Product	13885577940276

CASE II.

When Cyphers are annexed to either, or both Factors.

Rule. Place the significant Figures of the Factors in the same Manner as if there were no Cyphers. Omit the Cyphers annexed to both Factors in the Operation, until the total Product, to which the Cyphers before omitted must be annexed.

EXAMPLE.

Multiply	347690400
By	3006000
	20861424
	10430712
Product	1045157342400000

CASE III.

When the Multiplier is a Rectangle of some two Numbers, neither exceeding 12.

Rule. Multiply the Multiplicand by either of those Numbers, and the Product thence arising by the other: The last Product will be the true Product of the given Factors.

EX-

EXAMPLE.

Multiply 24069276
By 108.

```
 24069276
       12 × 9 = 108
 ---------
 288831312
         9
 ---------
Product 2599481808
 =========
```

MULTIPLICATION of MONEY, WEIGHT and MEASURE, is the multiplying of any Sum or Quantity by ſome abſolute Number; and may be thus performed:

RULE. Make the abſolute Number the Multiplicand, and the given Sum or Quantity the Multiplier.

Multiply by the Number expreſſed in the leaſt Denomination, and divide the Product by as many Units of its own Name as are equal to an Unit of the next occurring Denomination; reſerve the Quotient; Then multiply by the Number expreſſed in the aforeſaid next occurring Denomination, and to the Product add the Quotient reſerved, and divide the Sum by as many Units of its own Name as are equal to an Unit of its next occurring Denomination; reſerve the Quotient, and repeat the Operation with every Denomination of the Multiplier.

The last Sum (sometimes Quotient) and the Remainders after the several Divisions taken together, will constitute the Product required.

EXAMPLE.

What is the Value of 2463 Hogs at 2*l.* 6*s.* 3½*d.* each?

```
            2463
               2 Far. = ½
          4)4926
            1231½
2463×3d. =  7389
         12)8620½
             718 : 4½
2463×6s. = 14778
     2|0)1549|6 : 4½
          774 : 16 : 4½
2463×2l. = 4926
Answer     5700 : 16 : 4½  The Product.
```

N. B. Notwithstanding the foregoing Rule is general, yet the following Cases in some Degree become necessary.

CASE

C A S E I.

To multiply any Sum or Quantity by a Number not exceeding 12.

RULE. Place the given Number under the least Denomination of the given Sum, or Quantity, and draw a Line under the same.

Multiply the least Denomination by the given Number, and divide the Product by as many Units of its own Name as are equal to an Unit of the next occurring Denomination; set the Remainder under the Line, and let the Quotient be carried and added to the Product arising from the Multiplication of the next occurring Denomination: Divide the Sum by as many Units of its own Name as are equal to an Unit of its next occurring Denomination; set the Remainder under the Line; carry on the Quotient and proceed in every respect as above, until the last or greatest Denomination, which is integral, and must be wrought as in simple Multiplication.

E X A M P L E.

What does 8 Yards of Broad Cloth come to at 1*l.* 6*s.* 10½*d.* per Yard?

	£.	s.	d.	
	1	6	10½	
			8	
Answer	10	15	0	The Product.

CASE

CASE II.

When the given Number is a Rectangle of some two integral Numbers, neither exceeding 12.

RULE. Multiply the given Sum, or Quantity, by either of those Numbers (*per* Case the 1st) and the Product thence arising by the other: The last Product will be that required.

EXAMPLE.

Bought 24 Firkins of Butter for 15*s*. 6½*d*. per Firkin. What does it come to?

	s.	*d.*	
	15	6½	
		4×6=24	
	3	2	2
			6
Answer	£18	13	0 The Product.

CASE III.

When the given Number is not a Rectangle of some two integral Numbers, nor greater than 156.

RULE. Take the nearest Rectangle to the given Number, whether greater or less, and proceed therewith according to Case II; reserve the last Product: Then multi-

ply

ply the given Sum or Quantity by the Difference between the given Number and the aforesaid Rectangle; and add or subtract* the Product to or from the Product reserved: the Sum or the Difference will be the Answer respectively.

EXAMPLE.

What is the Value of 117 Gallons of Rum at 12*s.* 6*d.* per Gallon?

	s.	*d.*	
	12	6	
			$\overline{10 \times 12} - 3 = 117$
6	5	0	
		12	
75	0	0	
— 1	17	6	
£73	2	6	Answer

Of

* If the given Number be greater than the Rectangle taken, ADD; But if it be less, SUBTRACT.

Or otherwise thus,

	£	s.	d.	
		12	6	$\overline{10 \times 11} + 7 = 117$
	6	5	0	
			11	
	68	15	0	
+	4	7	6	
£	73	2	6	Answer as above.

MUL-

MULTIPLICATION TABLE, according to *Pythagoras*, is as follows:

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

MULTIPLICATION of VULGAR FRACTIONS, admits of two Cases.

First, When the Fractions are Simple, and of the same Denomination, or abstractly considered.

Secondly, When the Fractions are of se-

veral Kinds, and of Integers of different Denominations.

Rule, *In the first Case.* Multiply all the Numerators together for a Numerator of the Product, and all the Denominators together for a Denominator of the Product: The Fraction thus constituted will be the required Product of the given Fractions.

In the second Case, Reduce the whole and mixed Numbers to improper Fractions, and all the mixed Fractions to simple ones: Also reduce all the Fractions to others of the same Value, which shall have one Denomination common to them all (*viz.* Fractions of the same Integer) and proceed as in Case I.

EXAMPLE.

Multiply $\frac{2}{9}$ by $\frac{7}{8}$.

$2 \times 7 = 14$ Numerator.
$9 \times 8 = 72$ Denominator.

Hence $\frac{2}{9} \times \frac{7}{8} = \frac{14}{72} = \frac{7}{36}$ the Product.

Multiply $\frac{7}{8}$ of $\frac{3}{5}$ by $\frac{2}{21}$ of $\frac{18}{11}$.

$7 \times 3 \times 2 \times 18 = 756$ Numerator
$8 \times 5 \times 21 \times 11 = 9240$ Denominator.

Hence $\frac{7}{8} \times \frac{3}{5} \times \frac{2}{21} \times \frac{18}{11} = \frac{756}{9240} = \frac{9}{110}$ the Product.

Multiply

Multiply £ $14\frac{7}{8}$ by $\frac{3}{4}$ of a Shilling.

£ $14\frac{7}{8}$ = £ $\frac{119}{8}$ and s $\frac{3}{4}$ = £ $\frac{3}{80}$

therefore $\begin{cases} 119 \times 3 = 357 \text{ Num.} \\ 8 \times 80 = 640 \text{ Den.} \end{cases}$

hence £ $14\frac{7}{8}$ × s $\frac{3}{4}$ = £ $\frac{357}{640}$ = s 11 d $1\frac{3}{4}, \frac{1}{2}$ Product.

MULTIPLICATOR, } is the Number by which
MULTIPLIER, } any other Number, Sum or Quantity is multiplied.

MYRIAD, the Number of 1000.

N

NEAT WEIGHT, is the remaining Weight of any Commodity after every Deduction made.

NEGATIVE NUMBERS, are such as represent a State of Non-existence, or (according to the common Phrase) that which is less than Nothing.

NOTATION, is the Art of Writing, or noting down any proposed Number, and depends entirely upon a perfect Knowledge of Numeration.

NULLO, a Cypher or Nought.

NUMBER, is a Collection of Units.

NUMERATION, is the Art of reading all manner of Numbers, from the least to the

greatest that can be conceived, or expressed, The Method is thus:

RULE. Divide the given Number into Periods of six Places each, accounting from the right Hand towards the left, then will the Figure possessing the first Place in every Period represent as many Units, or single Things, as are expressed by the simple Value of the said Figure; The Figure in the second Place, as many Tens, and that in the third Place, as many Hundreds; the Figure in the fourth Place, as many Thousands, that in the fifth Place, as many Tens of Thousands; and that in the sixth Place, as many Hundreds of Thousands; only note, that an Unit of every succeeding Period towards the left Hand, is a Million of Times the Value of an Unit of its preceeding Period towards the right Hand, consequently the Units of the second Period will bear the Denomination of Millions; those of the third Period, Billions; those of the fourth, Trillions; of the fifth, Quadrillions; of the sixth, Quintillions; of the seventh, Sextillions; of the eighth, Septillions; of the ninth, Octillions; of the tenth, Nonillions, and so on, as far as you please. *See the Table.*

The TABLE.

Period	Figure	Place
Sixth Period, Quintillions.	3	Hundreds
	2	Tens
	4	Units
Fifth Period, Quadrillions.	1	Hundreds of Thousands
	2	Tens of Thousands
	3	Thousands
	4	Hundreds
	5	Tens
	6	Units
Fourth Period, Trillions.	7	Hundreds of Thousands
	8	Tens of Thousands
	9	Thousands
	4	Hundreds
	5	Tens
	6	Units
Third Period, Billions.	7	Hundreds of Thousands
	8	Tens of Thousands
	9	Thousands
	3	Hundreds
	2	Tens
	1	Units
Second Period, Millions.	5	Hundreds of Thousands
	6	Tens of Thousands
	7	Thousands
	8	Hundreds
	9	Tens
	4	Units
First Period, Simple Units.	3	Hundreds of Thousands
	2	Tens of Thousands
	1	Thousands
	7	Hundreds
	8	Tens
	9	Units

NUMERATOR of a VULGAR FRACTION, is the upper Term; and is so called because it enumerates or expresses the Number of the Parts which the Fraction absolutely consists of.

O

ODD NUMBERS, are such as cannot be divided by 2 without leaving a Remainder.

ORDINAL NUMBERS, are such as express the Order of Things.

P

PAR of EXCHANGE, is when the intrinsic Value of the Money of one Country is given for its like Value in that of another Country; that is, when there is an equality of Worth according to the respective Weight and Pureness when adjusted by the same Standard.

N. B. There is this Difference between the *Par* and the *Course* of *Exchange*.

The *Par* of *Exchange* is always fixed, and the same; But the *Course* of *Exchange* rises and falls upon several Occasions. *See Tables Foreign Money.*

PERFECT NUMBERS, are such that the Sums of their aliquot Parts are equal to the Numbers themselves.

PE-

PERIOD, (in Numeration and Notation) is a Number consisting of six Places or Figures; usually distinguished by a Comma or Point.

PERMUTATION, is a Rule which teaches to find all the different Positions or Changes any Number of Things are capable of undergoing; and is thus performed:

RULE. Let the given Number of Things be made the greatest Extream in a Series of arithmetical Progressionals, whose least Extream and common Difference are Unity, or one; produce all the Terms and multiply them continually together: The last Product will give the Number of Changes required.

EXAMPLE.

In how many different Positions may six Persons sit at Table?

6×5×4×3×2×1 = *720 Answer

```
  6
  5
 ---
 30
  4
 ---
120
  3
 ---
360
  2
 ---
*720
```

PHY-

PHYSICAL COMPOSITION, is the Art of mixing together two or more medicinal Simples of different Qualities* in such a Manner, that the Compound may be of any assigned intermediate Degree of Quality between the Extreams of those of the given Simples. The general Rule is as follows:

Let o be made to represent the temparate Quality; and from o each Way, produce the several Degrees of Temperature (proceeding from Unity) until the last on each Side is equal to the Degree of the greatest Extream of the given, or proposed Simples. Also let the Degrees on the left hand Side of the temperate Character represent the cold and moist Qualities, and those on the right Hand Side the hot and dry Qualities. Over the degrees of Temperature, place a Rank of Indices (whose first Term and common Difference are Unity) proceeding from the extream Degree of Cold and moist to the extream Degree of Heat and Drought

Things being thus premised it will be necessary to resolve the Rule into the following Cases.

CASE I.

The Quantities, and Qualities, of several Simples

* The Quality of every Simple is said to be either hot and dry, or cold and moist, or Temperate.

The temparate Quality is a Mean between the rest, and is the only one that does not admit of a comparitive Degree.

Simples being given separately: To find the Quality of their whole Composition.

RULE. Reduce the several Quantities to the same Denomination, and multiply each of them by the Indice of its respective Degree of Quality; add the Products together and divide the Sum by the total Quantity of the given Simples: The Quotient will be the Indice of the Degree expressing the Quality of the said Composition.

EXAMPLE.

An Apothecary has four Simples, *A*, *B*, *C*, *D*. *A* is temparate, *B* hot in the 3°, *C* hot in the 1°, and *D* cold in the 2°. Of these he has made a mixture, *viz.* 6 oz. of *A*, 4 oz. of *B*, 1 ℔ of *C*, and 1 ℔ 3 oz. of *D*. *Query*, The Quality of a Composition?

Indices	1	2	3	4	5	6	7
Degrees	3	2	1	0	1	2	3
	Cold, &c.			Temp.	Hot, &c.		

		oz.		Ind.		
A	- - - -	6	×	4	=	24
B	- - - -	4	×	7	=	28
C	- 1 lb =	12	×	5	=	60
D	1 lb : 3 oz. =	15	×	2	=	30
		37			37)	142 ($3\frac{31}{37}$ the
						111
						31

Indice of $1^{\circ}\frac{31}{37}$ of Cold, the Quality required.

C A S E II.

The Qualities of several Simples being given; to find a Quantity of each of them that would make a Composition of any mean Degree of Quality assigned, between the Extreams of those of the given Simples.

Rule. Place the Indices of the given Simples one under another, as in Addition of Integers, and the Indice of the Quality required on the left-hand Side of them for a mean Rate; Link the Indices of the Simples together so as the one may be less and the other greater than the Indice of the Quality required, and proceed as in Alligation Alternate: The Differences will be the Quantities required, according to the respective Indices to which they stand opposed.

E X A M P L E.

An Apothecary has four Simples, *viz.* *A*

A hot in the 3°, *B* cold in the 2°, *C* cold in the 4°, and *D* hot in the 1°. of these he is desirous of making a Mixture of a temparate Quality: *Query*, What Quantity of each Simple must be taken?

Indices	1	2	3	4	5	6	7	8	9.
Degrees	4	3	2	1	0	1	2	3	4.

Cold, &c. — Temp. — Hot, &c.

5	8	— 4	Answer in any Denomination proposed.
	3	— 1	
	1	— 3	
	6	— 2	

PROOF by Case I,

Ind.

4 × 8 = 32
1 × 3 = 3
3 × 1 = 3
2 × 6 = 12

10 *10) 50

5 Answer

N. B. If the whole Composition is to consist of some certain Quantity proposed, it will be

As the total Sum of the Quantities (found by the last Case) is to each of the said Quantities severally, so is the proposed Quantity of the whole Composition to each of

of the Quantities of the given Simples respectively.

PLANE NUMBERS, are such as are produced by the Multiplication of any two Numbers into each other; a Rectangle or Product.

POLITICAL ARITHMETIC, is that which considers the Extent and Value of Lands, Taxes, Number of People, &c. of any Government or Common Wealth.

POLYGONAL NUMBERS, are such as are the successive Sums arising from the Additions of the several Terms in a Series of arithmetical Progressionals, proceeding from Unity.

N. B. The Polygon which gives the Denomination to the Numbers, has always two Sides more than are expressed by the common Difference of the progressional Terms, from which the Numbers are produced.

Any Polygonal Number (having its Side given) may be found by the following Rule.

From the Number of the Polygon's Sides subtract 2, and by the Difference multiply the Square of the given Side; reserve the Product. Also from the Number of the Polygon's Sides subtract 4; multiply the Difference by the given Side; subtract the Product thus found from the Product before reserved, and divide the Difference by 2: The Quotient will be the polygonal Number required.

EX-

EXAMPLE.

The Side of an octagonal Number is 3: *Query*, The Number itself?

‡8 = N° of Sides	‖3 = the given Side	‡8
2	‖3	4
—	— 1	—
*6	9	4
=	*6	‖3
	—	—
	54	12§
	12§	=
	—	
	2)42	
	—	
	21 Answer	

POSITION, is a Rule wherein the required Number or Quantity is taken at Pleasure, and by means of one or more Suppositions, proceeds by Consequence according to the Tenor of the Question, until the Number or Quantity at first only supposed becomes absolutely known. *See Single and Double Position.*

POWER. The Powers of any Number are no other than a Rank or Series of Geometrical Progressionals continued, whose least Extream and Ratio are each equal to the Number itself. Hence any Number in its primitive State is said to be of the first Power; when squared, of the second Power; and when cubed, of the third Power, &c. according

cording to the Succession of the Terms. See *Table of Powers.*

PRACTICAL ARITHMETIC, is that which shews the Method of working by Numbers so as to be useful in Business, and is founded upon five primative Rules; namely, Numeration, Addition, Subtraction, Multiplication and Division; by the Help of which Rules all others are performed.

PRACTICE, is a compendious Way of finding the Value of any Quantity of Goods; the Price of an Integer of that Quantity being known.

CASE I.

When the given Price of an Integer is any Sum less than a Penny.

RULE. Divide the given Number or Quantity by such aliquot Parts of a Penny as are equal to the given Price, and add the Quotients together; their Sum will be the Value of the said Quantity in Pence; which reduce to Shillings and Pounds by dividing by 12 and by 20.

N. B. It is necessary that there be two Columns, the first for the Money, and the other for the Parts; as in the following Examples.

EX

EXAMPLES.

What is the Value of 36942, at ¼ each?

Money d.	Parts	
0 ¼	¼	36942
		12)9235½
		2|0)76|9 7½
		£38 9 7½ Anfwer

What is the Value of 4679 at ½ each?

d.		
0 ½	½	4679
		12)2339½
		2|0)19|4 11½
		£9 14 11½ Anfwer

What

What is the Value of 7632, at ¾ each?

Money d.		
0 ½	½ }	7632
0 ¼	¼ }	3816
		1908
0 ¾		12)5724
		2|0)47|7
		£23 17 Anfwer

N. B. Sometimes it is better to take Parts of Parts, &c. then the foregoing Example would have ftood thus:

d.		
0 ½	½	7632
0 ¼	½	3816
		1908
0 ¾		12)5724
		2|0)47|7
		£23 17 Anfwer as above.

CASE

CASE II.

When the given Price of an Integer is leſs than a Shilling; but not leſs than a Penny.

RULE. Divide the given Number or Quantity by ſuch aliquot Parts of a Shilling as are equal to the given Price, and add the Quotients together: Their Sum will be the Value of the ſaid given Quantity in Shillings; which reduce to Pounds by dividing by 20. The like is here to be underſtood as in Caſe I. with reſpect to the Parts of Parts.

EXAMPLE.

What is the Value of 2769 at $9\frac{1}{2}$*d.* each?

<table>
<tr><td>d.</td><td></td><td></td></tr>
<tr><td>6</td><td>$\frac{1}{2}$</td><td>2769</td></tr>
<tr><td>3</td><td>$\frac{1}{2}$</td><td>$1384\frac{1}{2}$</td></tr>
<tr><td>$\frac{1}{2}$</td><td>$\frac{1}{6}$</td><td>$692\frac{1}{4}$</td></tr>
<tr><td></td><td></td><td>$115\frac{1}{4}$</td></tr>
<tr><td>$9\frac{1}{2}$</td><td></td><td></td></tr>
<tr><td></td><td></td><td>2|0)219(2</td></tr>
<tr><td></td><td></td><td>£109 : 12 Anſwer</td></tr>
</table>

CASE III.

When the given Price of an Integer is leſs than 2 Shillings, but not leſs than one Shilling.

Rule. Proceed with so much of the given Price as is above a Shilling, according to Case II. and add the given Number or Quantity, with the Quotients: The Sum will be the Value of the said Quantity in Shillings; which reduce to Pounds as before taught.

EXAMPLE.

What is the Value of 2769 at 1*s.* 4¾*d.* each?

d.		
4	⅓	2769
0½	⅛	923
0¼	½	115 4½
		57 8¼
4¾		2|0)386|5 0¾
		£193 5 0¾ Answer

CASE IV.

When the given Price of an Integer is any even Number of Shillings under 20.

Rule. Multiply the given Number or Quantity, by half the given Price, and double the Figure in the Unit's Place of the Product for Shillings, the rest of the Product will be Pounds: The Pounds and Shillings so found will be the Value of the given Quantity.

EX-

EXAMPLE.

What is the Value of 369 at 16*s.* each?

369	
8	
£295 4	Answer

CASE V.

When the given Price of an Integer is any odd Number of Shillings under 20.

RULE. Multiply the given Quantity by the given Number of Shillings, and divide the Product by 20: The Quotient will be the Value required in Pounds, &c.

EXAMPLE.

What is the Value of 468 at 13*s* each?

468	
13	
1404	
468	
2|0)608|4	
£304 4	Answer

CASE VI.

When the given Price of an Integer is

 Shillings

Shillings and Pence; and they the aliquot Parts of a Pound.

Rule. Divide the given Quantity by the said aliquot Parts, and add the Quotients together; their Sum will be the Value required in Pounds, &c. The like is here to be understood as in the other Cases with respect to the Parts of Parts.

EXAMPLE.

What is the Value of 469 at 13s 4*d*. each?

s. d.		
10 0	$\frac{1}{2}$	469
3 4	$\frac{1}{3}$	234 : 10
		78 : 3 : 4
13 4		£312 : 13 : 4 Answer

CASE VII.

When the given Price of an Integer is Shillings, Pence, and Farthings; and they not the aliquot Parts of a Pound.

Rule. Multiply the given Quantity by the Shillings in the given Price; reserve the Product; and proceed with the rest of the Price as in Case II; add the Quotients and Product reserved together, and divide the Sum by 20: The Quotient so found will be the Value required in Pounds, &c.

EX-

EXAMPLE.

What is the Value of 276 at 17*s.* 7½*d.* each?

d.		
6 .	½	276
		17
		1932
		276
		4692
1½ .	¼	138
		34 : 6
7½		2|0)486|4 : 6
		£243 : 4 : 6 Answer

CASE VIII.

When the given Price of an Integer is Pounds, Shillings, Pence, &c.

Rule. Multiply the given Quantity by the Pounds in the given Price; reserve the Product; find the Amount of the given Quantity according to the foregoing Cases, with the rest of the Price, and add it to the Product before reserved: The Sum will be the required Value of the given Quantity, in Pounds, &c.

EXAMPLE.

What is the Value of 269 at 3*l.* 1*s.* 7½*d.* each?

d.

d. 6	$\frac{1}{2}$	269
		3
		807
$1\frac{1}{2}$	$\frac{1}{4}$	134 : 6
		33 : $7\frac{1}{2}$
$7\frac{1}{2}$		
		2|0)43|7 : $1\frac{1}{2}$
		21 : 17 : $1\frac{1}{2}$
		£828 : 17 : $1\frac{1}{2}$ Anfwer

C A S E IX.

When the given Quantity, as well as the given Price of its Integer, is of feveral Denominations.

Rule. Multiply the given Price by the Integers of the given Quantity, as in Multiplication of Money; referve the Product; then divide the given Price by fuch aliquot Parts of the Integer of the given Quantity as are equal to the remaining Part of the given Quantity, and add the Quotients and the Product referved together: Their Sum will be the required Value of the given Quantity in Pounds, &c.

E X A M P L E.

What is the Value of 11C. 3qr. 14lb at 2*l.* 10*s.* $4\frac{1}{2}$ per C?

Qr.

Qr.	lb		£	s	d
2	0	½	2	10	4½
					11
			27	14	1½
1	0	½	1	5	2
0	14	½	0	12	7
			0	6	3½
3	14				
			£29	18	2¼ Anſwer

PRACTICE TABLE, ſee Tables of aliquot Parts.

PRESENT WORTH, the immediate Value. In Rebate or Diſcount 'tis ſuch a certain Sum, paid in Conſideration for ſome Note, Debt, &c. not yet due; as if put to Intereſt at any propoſed Rate per Cent. per Ann. and for the Time of Forbearance, its Amount would be equal to the ſaid Note, &c. *See Rebate or Diſcount, Purchaſing Annuities, &c.*

PRIME NUMBERS, are ſuch as cannot be divided by any other Number beſides itſelf or Unity, without leaving a Remainder.

PRINCIPAL, the Sum lent or put to Intereſt.

PRODUCT, is the Number, Sum or Quantity, ariſing from the Multiplication of any two or more Numbers, Sums or Quantities into each other.

PROFIT and LOSS, is a Rule which teaches how to eſtimate or determine the Gain or Loſs upon the Bargain and Sale of every Article in Trade; and is thus performed:

RULE.

Rule. Find the Value of the Goods at the Rate for which they were bought; Also find their Value at the Rate for which they were sold: The Difference of the Values so found will be the Gain or Loss required; that is, if the Sum for which they were bought, exceeds that for which they were sold; the Excess is the Loss. But if the Sum for which they were sold exceeds that for which they were bought, the Excess is the Gain.

EXAMPLE.

Bought 2Cwt. of Chocolate at the Rate of 20 Guineas per C. and sold again at 5s. per ℔: *Query*, What I gained or lost by the Bargain?

Gu.	£	Cwt.	℔
20 =	21	2 =	224
	2	*s.*	
	£42*	5 | ¼	224
			56
			42*
			£14 Answer Gain.

N.B. When the Rate of the Gain or Loss per Cent. is required, it will be

As the whole Purchase-Money is to the entire Gain or Loss, so is 100*l.* to the Rate per Cent. of the Gain or Loss respectively. The like is to be understood when the Rate

of

of the Gain or Loſs on any propoſed Quantity is required; that is, as the given Quantity of the Goods is to the entire Gain or Loſs, ſo is the propoſed Quantity to the Gain or Loſs thereon reſpectively.

Likewiſe When it is required at what Rate any propoſed Quantity muſt be ſold ſo as to gain any aſſigned Sum on the Whole.

I. To the Purchaſe-Money add the aſſigned Gain, and reſerve the Sum.

II. As the whole Quantity of the Goods is to the Sum reſerved, ſo is the Quantity propoſed to the Rate required. In like Manner, when the Rate is required at which any propoſed Quantity muſt be ſold, ſo as to gain an aſſigned Sum per Cent.

I. Add the aſſigned Gain to 100*l.* Then as 100*l.* is to that Sum, ſo is the Purchaſe-Money to a fourth Sum.

II. As the whole Quantity of the Goods is to the fourth Sum, ſo is the Quantity propoſed to the Rate required.

PROGRESSION, ſee geometrical and arithmetical Progreſſion.

PROMPT PAYMENT, immediate, preſent, without Delay, or Forbearance.

PROPER FRACTIONS, are ſuch as have their Numerators leſs than their Denominators.

PROPORTION, a ſimilitude of Ratios. *See geometrical, arithmetical, and harmonical Proportion.*

PURCHASING of ANNUITIES, is a Rule which teaches how to eſtimate the preſent

 Worth

Worth of any Annuity for a determinate Space of Time, and is as follows.

CASE I.

The Annuity, Time, and Rate being given; to find the present Worth.

RULE. *First, At simple Interest.* To the Square of the *Time*, multiplied by the *Ratio*, add double the *Time*, and from the Sum subtract the Rectangle of the *Time* into the *Ratio*; reserve the Difference. Also to double the said Rectangle add the Number 2, and by the Sum so found divide the Difference before reserved; multiply the Quotient by the *Annuity*, and the Product will be equal to the *present Worth*.

N. B. If the Payments are half-yearly, work with half the *Annuity*, half the *Ratio*, and double the *Time*. If Quarterly, with four times the *Time*, a Quarter of the *Ratio*, and a Quarter of the *Annuity*.

Secondly, At compound Interest. Raise the *Ratio* to a Power whose Exponent is equal to the *Time*, and by the Power so raised divide the *Annuity*; subtract the Quotient from the *Annuity*, and divide the Difference by the *Ratio*, made less by an Unit: The Quotient so found is the *present Worth*.

EXAMPLE.

What present Money will purchase the Lease

Lease of an Estate of 150*l.* per Ann. there being five Years to come, allowing the Buyer 5*l.* per Cent.

I. At simple Intereſt.

```
  5        5        ,05        150
  2        5          5        4,4§
  —        —          —        ———
 *10       25        ,25       600
  ==      ,05          2       600
         ————         —        ———
         1,25        ,50     £660,0 Anſwer
        *10          2,0       ====
         ————        ———
         11,25       2,5||
           ,25‡      ———
         ————
||2,5)11,00,(4,4§
      100
     ————
       100
       100
      ====
```


II. A

II. At Compound Interest.

```
         1,05
         1,05
         ----
          525
         105
        -----
       1,1025
       1,1025
       ------
        55125
       22050
     121275
    ---------
   1,21550625
         1,05
   ----------
    607753125
  121550625
  -----------
1,2762815625)150,0000000000(117,5289
             12762815625
             -----------
              22371843750
              12762815625
              -----------
               96090281250
               89339709375
               -----------
                67505718750
                63814078125
                -----------
                 3691640625
```

Continued in the following Page.

	25525631250
	113907750000
	102102525000
	118052250000
	114865340625
1,05	150,
1,	117,5289
§,05	§,05)32,4711

£ s d.

£649,422 = 649 : 8 : 5¼,12 Ans.

C A S E II.

The *present Worth, Time*, and *Rate* being given; to find the *Annuity*.

RULE. *First, At Simple Interest.* Multiply the doubled Rectangle of the *Time* into the *Ratio* by the *present Worth*, and to the Product add double the *present Worth*; reserve the Sum: Then to the Square of the *Time*, multiplied by the *Ratio*, add double the *Time*; and from the Sum subtract the Rectangle of the *Ratio* into the *Time*, and by the Difference so found divide the Sum reserved: The Quotient will be equal to the *Annuity*.

N. B. If the Payments are half-yearly, work with half the *Ratio*, double the *Time*, and double the *present Worth*. If Quarterly, with a Quarter of the *Ratio*,

Ratio, four times the *Time*, and four times the *present Worth*.

Secondly, *At Compound Intereſt*. Raiſe the *Ratio* to a Power whoſe Exponent is equal to the *Time*, and reſerve it: Multiply the Power reſerved by the *preſent Worth*; reſerve the Product: Multiply the Product reſerved by the *Ratio*, and from the Product ſo found ſubtract the Product reſerved; divide the Difference by the reſerved Power made leſs by an Unit, and the Quotient will be equal to the *Annuity*.

EXAMPLE.

What Annuity, to continue five Years, may be purchaſed for 660*l.* allowing ſimple Intereſt at 5*l.* per Cent. or for 649*l.* 8*s.* 5*d.*¼.12|, allowing compound Intereſt at the ſame Rate?

I. At Simple Intereſt.

660	,05	5	5
2	5	5	2
1320*	,25	25	10¼
	2	,05	
	,50	1,25	
	660	10¼	
	330,00	11,25	
	1320	,25	
	11)1650	11 ..	
	£150 Anſwer		

II. At

II. At Compound Interest.

```
 £.  s  d
649  8  5½.12 = 649,422*
               1,05
               1,05
               ----
                525
               105
             ------
             1,1025
             1,1025
             ------
              55125
             22050
           121275
         ----------
         1,21550625
               1,05
         ----------
          607753125
         121550625
        -----------
        1,2762815625§
             649,422*
       -------------
           25525631250
          25525631250
         51051262500
        114865340625
        51051262500
       76576893750
      -----------------
      828,84532488187504‡
                  1,05
      -----------------
       41442266244093750
      8288453248818750
      --------------------
      870,2875911259687 50
      828,8453248818750
      --------------------
       41,442266244093 75
```

Continued in the next Page.

1,2762815625§
1,

,2762815625)41,44226624409375(150 Ans.
2762815625

13814109994
13814078125

318690

CASE III.

The *Annuity*, *Present Worth*, and *Time* being given; to find the *Rate*.

RULE. *First*, *At Simple Interest*. To the doubled Rectangle of the *Present Worth* into the *Time* add the Rectangle of the *Annuity* into the *Time*, and from the Sum subtract the Product of the *Annuity* multiplied by the Square of the *Time*; reserve the Difference.

Also from the Rectangle of the *Annuity* into the *Time* subtract the *Present Worth*; multiply the Difference by 200, and divide the Product by the Difference before reserved: The Quotient will be equal to the *Rate per Cent. per Ann.*

N. B. If the Payments are half-yearly, work with half the *Annuity* and double the *Time*: If quarterly, with a Quarter of the *Annuity* and four times the *Time*. In such Case the Quotient will be equal to the one half or the one fourth of the *Rate* respectively.

Secondly,

Secondly, At Compound Interest. As this Case requires an algebraic Solution, I shall omit it, it being foreign to the present Design.

EXAMPLE.

A Person bought an Annuity of 150*l.* to continue 5 Years for 660*l.* *Query*, What Rate per Cent. simple Interest, he was allowed for his Money?

£	£	
660 Pres. wth.	150 Ann.	5 Time
5	5	5
3300	750§	25
2	660	150
6600	90	1250
750§	200	25
7350*	18000‡	3750*

36|00(180|00‡(5*l.* Answer
180
...

CASE IV.

The *Annuity, present Worth* and *Rate*, being given; to find the *Time*.

RULE. *First, At Simple Interest.* From double the *Annuity* subtract the doubled Rectangle of the *Present Worth* into the *Ra-*

tio, and divide the Difference by the Product of the *Annuity* multiplied by the *Ratio*; and from the Quotient subtract an Unit; reserve the Difference. Divide double the *Present Worth* by the Rectangle of the *Annuity* into the *Ratio*, and to the Quotient add the Square of half the Difference reserved; extract the square Root of the Sum, from which Root subtract half the Difference reserved: The Difference so found will be equal to the *Time* required.

N. B. If the Payments are half-yearly, work with half the *Annuity* and half the *Ratio*. If quarterly, with a Quarter of the *Annuity* and a Quarter of the *Ratio*; and in such Case the Difference will be equal to Double, or four times the *Time* required, respectively.

Secondly, At Compound Interest. To the *Present Worth* add the *Annuity*, and from the Sum subtract the Rectangle of the *Present Worth* into the *Ratio*, divide the *Annuity* by the Difference; the Quotient will be a Power of the *Ratio*, whose Exponent is equal to the *Time*: Therefore divide the said Quotient and the successive Quotients continually by the *Ratio* until the last Quotient is an Unit, and the Remainder o the Number of those Divisions will be equal to the *Time* required.

EXAMPLE.

If an Annuity of 150*l.* can be purchased for 660*l.* at simple Interest, or 649*l.* 8*s.* 5*d*.17. compound Interest, the Rate being

5*l. per Cent*; what is the Time of its Continuance.

I. At Simple Intereſt.

```
 £                    £                          £
150 Ann.            660 Preſ. wth.           150 Ann.
  2                   ,05                        ,05
 ___                 _____                      _____
 300                 33,00                      §7,50
  66*                  2                         =====
 ___                 _____
§7,5)234,0(31,2       66*
     225      1,     =====
     ___     ____
      90    30,2|| Quotient reſerved.
      75    ====
     ___
     150
     150
     ===          £
                660 Preſent Worth
                  2
                _____
      §7,5)1320,0(176
              75   228,01§
             ___   _______
2)30,2||     570  √404,01(20,1-
 ____        525   4           15,1‡
 15,1‡       ___  ____       _____
 15,1        450  401)0401  √5 Years Anſ.
 ____        450       401  ==
 151         ===       ===
 755
 151
 _____
 228,01§
 ======
```

II. At Compound Interest.

	£	s	d	
649,4215006 =	649	8	5,17	649,4215006
150				1,05
799,4215006				32471075030
681,89257563*				6494215006
117,528924497§				681,892575630*

117,528924497§)150,00000000(1,2762815625

11752892497

32471075030

23505784994

89652900360

82270247479

73826528810

70517354982

33091738280

23505784994

95859532860

94023139976

18363928840

11752892497

66110363430

58764462485

73459009450

70517354982

29416544680

23505784994

59107596860

58764462485

```
                               1,05            1,05
1,05|1,2762815625(1,21550625(1,157625(
     105                105            105
     ---                ---            ---
      226                165            107
      210                105            105
      ---                ---            ---
       162                605            262
       105                525            210
       ---                ---            ---
        578                800            525
        525                735            525
        ---                ---            ---
         531                656
         525                630
         ---                ---
          656               262
          630               210
          ---               ---
           262               525
           210               525
           ---               ---
            525              ...
            525
            ...
  1,05     1,05
1,1025(1,05(1
105      105
-----    ---
  525    ...
  525
  ...
```

Here the Number of Divisions are five, equal to the Number of Years required.

PURCHASING ANNUITIES for LIVES, *see Valuation of Annuities for Lives.*

PURCHASING of ANNUITIES in REVERSION.

CASE I.

The *Annuity, Rate per Cent. Time* of Continuance, and also the *Time* before it commences, being given; to find the *Present Worth.*

RULE. *(Either at simple or compound Interest)* First. Find the present Worth of the proposed *Rate* for the *Time* of its Continuance after it Commences. *(Per Case* I. *of Purchasing Annuities)*

Secondly, Find what Principal, being put to Interest at the above *Rate* for the Time before the *Annuity* commences, will amount to the present worth found as above: The Principal so found will be equal to the *Present Worth* required.

EXAMPLE.

An Annuity of 150*l.* to commence at the End of 4 Years, and then to continue 5 Years, being to be sold: *Query,* Its present Worth, allowing the Purchaser 5*l. per Cent,* for his Money?

I. At Simple Interest.

The present Worth of the *Annuity* for the *Time* of its Continuance being 660*l.* *(per Exam. Case* I. *Pur. Ann.)* therefore *(per Case* III. *of Int.*

,05
4

,20
1,0

1,2)660,0(550*l. The present Worth* required
600

60
60

·0

II. At Compound Interest.

Here the Present Worth for the *Time* of Continuance is 649,4215*l.* (*per Ex. Case* I. *Pur. Ann.*) therefore (*Per Case* III. *Int.*)

1,05

```
      1,05
      1,05
      ----
       525
      105
      ------
      1,1025
      1,1025
      ------
       55125
      22050
   121275
   ----------
1,21550625)649,42150000(534,28=534l. 5s.
           607753125'          7d.2, the Present
           ---------           Worth required.
            416683750
            364651875
            ---------
             520318750
             486202500
             ---------
              341162500
              243101250
              ---------
               980612500
               972405000
               ---------
```

CASE II.

The *Present Worth*, *Rate*, *Time* of Continuance, and also the Time before it commences, being given; to find the *Annuity*.

RULE. *(Either at simple or compound Int.)*

First,

First, Find the Amount of the *Present Worth* at the proposed *Rate* for the *Time* before the *Annuity* commences. (*Per Case* II. *Int.*)

Secondly, Find what *Annuity* may be purchased with the said Amount at the same *Rate* for the *Time* of Continuance after it commences. (*Per Case* II. *Pur. Ann.*) The *Annuity* so found will be that required.

EXAMPLE.

A young Gentleman, 17 Years old, proposed to advance immediately 534*l.* 5*s.* 7¼*d.* at compound Interest; or 550*l.* at simple Interest; in Consideration of an Annuity to continue five Years, and to commence at the *Time* he comes to Age: *Query*, What the Annuity must be, so that he may gain 5*l.* *per Cent.* by his Money?

I. At Simple Interest.

£
550
4
———
2200
,05
———
110,00
550,
———
660*

Then $\overline{5\times,05}+1=1,25$

And $\overline{5\times 5\times,05}+\overline{5\times 2}-\overline{5\times,05}=11$

therefore $\frac{1,25}{11}\times\overline{660^{*}\times 2}=$ £150 the Annuity required.

 II. At

II. At Compound Interest.

£ s d.

$534\ 5\ 7\frac{1}{4} = 534{,}28$

And $534{,}28 \times \overline{1{,}05}^{4} = 649{,}4215$

then $\dfrac{649{,}4215 \times \overline{1{,}05}^{5} \times 1{,}05 - 649{,}4215 \times \overline{1{,}05}^{5}}{\overline{1{,}05}^{5} - 1}$

$= 150$£ the Annuity required.

PURCHASING of FREEHOLD ESTATES,

or such as continue for ever, is the finding such a certain Sum as if put to Interest at any proposed Rate, would produce the yearly Rent.

CASE I.

To find the *present Worth* of a Freehold Estate; the *yearly Rent** and *Rate* being given.

RULE. Divide the *yearly Rent* by the *Ratio*: (Simple Interest) The Quotient will be equal to the *present Worth.*

EXAMPLE.

What is the present Worth of a Freehold Estate whose neat Produce is 150*l. per Ann.* allowing 5*l. per Cent.* upon the Purchase?

£

* What is here meant by the yearly Rent is the neat annual Produce of an Estate after the Land-Tax and other Incumbrances are paid.

£
,05)150,00

£3000 Answer

N. B. Where there is much Timber or other Valuables upon the Estate, there ought to be a separate Consideration.

If the Estate consists chiefly in Houses, it ought to be purchased at a very high Rate of Interest, on Account of Insurances and frequent Repairs.

CASE II.

The *Present Worth* of a Freehold Estate, and the *Rate per Cent.* being given to find the *yearly Rent.*

RULE. Multiply the *present Worth* by the *Ratio* (simp. Int.) the Product will be equal to the *yearly Rent.*

EXAMPLE.

What yearly Rent, to continue for ever, may be purchased for 3000*l.* allowing 5*l. per Cent.* for the Money?

3000
,05

£150,00 Answer

CASE III.

The *Present Worth* and *yearly Rent* being given to find the *Rate per Cent.*

Rule. Multiply the *yearly Rent* by 100, and divide the Product by the *present Worth*; The Quotient will be equal to the *Rate per Cent*.

EXAMPLE.

The present Worth of a Freehold Estate of 150*l.* *per Ann.* is 3000*l.* What ithse Rate of Interest.

£
150
100
3|000)15|000
£5 Answer

PURCHASING of FREEHOLD ESTATES in REVERSION.

CASE I.

The *yearly Rent* and *Rate per Cent.* being given; to find the *present Worth* of the Reversion of a Freehold Estate to commence at the End of any proposed Time.

Rule. *First*, Find the present Worth of the Estate for the whole Time. *(per Case* I. *of Purchasing Freehold Estates)*

Secondly, Find what Principal being put Interest at the to given *Rate*, and for the Time before the Estate commences will amount to the present Worth before found *(per Case*

Case III. *Comp. Interest*) Such Principal will be equal to the *present Worth* required.

EXAMPLE.

What is the present Worth of a Freehold Estate of 150*l.* *per Annum*, not to commence until the Expiration of 4 Years, allowing 5*l* *per Cent*. for the Purchase Money?

```
       £               ____4
,05)150,00          1,05 = 1,21550625*
    ______

1,21550625*)3000,00000000(2468,1 = 2468l
             243101250               2s. Answer.
             ___________
              568987500
              486202500
              ___________
               827850000
               729303750
               ___________
                985462500
                972405000
                ___________
                 130575000
                 121550625
                 ___________
```

CASE II.

The *Present Worth* of the Reversion of a Freehold Estate, *Rate per Cent*. and *Time* before it commences being given; to find the *yearly Rent*.

RULE. *First*, Find what the *present Worth* would

would amount to at the given *Rate*, and for the *Time* before the Estate commences (*per Case* II. *Compound Interest*)

Secondly, Find what yearly Rent may be purchased for the said Amount (*per Case* II. *Purchasing Freehold Estates*) and it will be equal to that required.

EXAMPLE.

What yearly Rent, to commence at the Expiration of 4 Years, and then to continue for ever, may be purchased for 2468*l.* 2*s.* 08, allowing 5*l* for the Purchase Money.

$$\text{I.}\quad \overset{\pounds}{2468}\ \ \overset{s}{2}.\ 08 = 2468{,}108$$

and $2468{,}108 \times \overline{1{,}05}^{4} = 3000$

therefore $3000 \times ,05 = 150l$ Answer

PURCHASING of STOCK, is the finding the Value (in ready Money) of any transferable nominal Sum deposited in any of the sinking Funds. This admits of two Cases.

CASE I.

When the Price of Stock is under Par: that is, less than 100*l.*

RULE. Multiply the given Stock by the given Price, and divide the Product by 100: The Quotient will be equal to the Purchase Money required.

EX-

EXAMPLE.

What is the Value of 246*l.* Bank Stock, at $78\frac{1}{8}$ *per Cent*?

```
 £.
78⅛ = 78,875
         246
      ------
      473250
     315500
    157750
    ---------
1|00)194|03,250
    ---------        £.   s. d
    194,0325 = 194  0  7¾,2  Ans.
```

CASE II.

When the Price of Stock is above Par; that is, more than 100*l.*

RULE. Find the Value of the given Stock with so much of the given Price as is above Par (*per Case I*) add the Value so found to the given Stock, and the Sum will be equal to the purchase Money required.

EXAMPLE.

What is the Value of 3646*l.* South-Sea Old Annuities, at $104\frac{3}{5}$ *per Cent*.

£.

$$4\tfrac{3}{5} = 4{,}6$$

£	s	d	
3646	0	0	
167	14	$3\frac{3}{4}$,36	
£3813	14	$3\frac{3}{4}$,36	Answer

3646
4,6

21876
14584

1|00)167|71,6

	£	s	d
167,716 =	167	14	$3\frac{3}{4}$,36

PYRAMIDICAL NUMBERS, are such as are raised from Polygonal Numbers, in the same Manner as the Polygonal Numbers are raised from arithmetical Progressional ones.

QUA-

Q

QUADRUPARTION, a dividing by four.
QUARTERNION, the Number of four.
QUINARIUS, the Number of five.
QUOTIENT, in Division, is the Number which shews how often the Divisor is contained in the Dividend.

R

RATIO, the Proportion or mutual Relation of two Quantities of the same Kind to one another. In simple Interest it is the Interest of 1*l.* for one Year at any proposed Rate per Cent. per Ann. but in compound Interest it is the Amount of 1*l.* for one Year at any proposed Rate per Cent. per Annum. *See Table of Ratios.*

RATIONAL NUMBERS, are those between which there is an expressible Proportion.

REASON, the Rate or Proportion between any two Quantities.

REBATE or DISCOUNT, admits of four Cases, which are as follow.

CASE I.

The Sum to be discounted, Rate, and Time being given, to find the Present Worth.

RULE. *First. At simple Interest.* To the Rectangle of the Time into the Ratio add 1, and with that Sum divide the Sum to be dis-

discounted: The Quotient will be the Present Worth.

Secondly. At Compound Interest. Raise the Ratio to a Power whose Exponent is equal to the given Time; and with the said Power divide the Sum to be discounted; The Quotient will be the Present Worth.

N. B. When the given Time does not consist of exact Years: Raise the Ratio to a Power whose Exponent is equal to the given Years, and reserve it: Also Raise the Ratio to a Power whose Exponent is one more than the given Years, and from the Power so raised subtract the Power reserved; multiply the Difference by the Decimal Parts of the given Time, and to the Product add the Power reserved: That Sum will be the equated Power, with which proceed as before directed. *The like is to be understood in compound Interest.*

EXAMPLE.

What is the present Worth of a Legacy of 578*l*. 16*s*. 3*d*. payable at the End of three Years, allowing a Discount of 5*l*. *per Cent*?

I. At

P

At Simple Interest.

£ s. d.
578 16 3 = 578,8125*

,05
3
———
,15
1,
———
1,15)578,8125*(503,3152 = £503 6s 3½d Ans.
575
———
381
345
———
362
345
———
175
115
———
600
575
———
250
230
———
200
115
———

II. At

II. At Compound Interest.

£	s	d		£
578	16	3	=	578,8125

```
         1,05
         1,05
        -----
         525
        105
        -----
        1,1025
         1,05
        -----
        55125
       11025
      --------                    £
      1,157625(578,812500(500 Anſr.
              5788125''
              --------
                     00
                     ==
```

N. B. Unleſs the given Time is greater than one Year, Compound Intereſt cannot with Propriety be applied.

C A S E II.

The Preſent Worth, Time and Rate being given, to find the Sum diſcounted.

RULE. *Firſt. At Simple Intereſt.* Multiply the Rectangle of the Preſent Worth into the Time by the Ratio, and to the Product add the Preſent Worth: That Sum will be equal to the Sum diſcounted.

Secondly. At Compound Intereſt. Raiſe the Ratio

Ratio to a Power whose Exponent is equal to the given Time, and multiply the said Power by the Present Worth: The Product will be equal to the Sum discounted.

EXAMPLE.

The Present Worth of a Legacy upon a Discount of 5*l.* *per Cent.* for three Years, at Simple Interest, is 503*l.* 6*s.* $3\frac{1}{2}$*d.*6 at Compound Interest 500*l.* *Query*, The Sum left?

I. At Simple Interest.

£ s d
503 6 $3\frac{1}{2}$,6 = 503,31522
3
1509,94566
,05
75,4972830
503,31522
578,8125030 = 578 16 3 Ans. (£ s d)

II. At

II. At Compound Interest.

```
    1,05
    1,05
    ----
     525
    105
    ------
   1,1025
     1,05
  -------
   55125
  11025
  --------
  1,157625
       500
  ----------
  578,812500 = 578 16 3 Answer
                 £   s  d
```

CASE III.

The Sum discounted, Present Worth, and Time being given, to find the Rate *per Cent.*

RULE. *First. At Simple Interest.* From the Sum discounted subtract the Present Worth; multiply the Difference by 100, and divide the Product by the Rectangle of the Time into the Present Worth: The Quotient will be equal to the Rate required.

Secondly. At Compound Interest. Divide the Sum discounted by the Present Worth, and extract the Root of the Quotient (the Exponent of whose Power is equal to the given Time) The Root so found will be the Ratio of the Rate *per Cent.*

N. B.

N. B. If the given Time does not consist of exact Years, there must be two Roots extracted from the Quotient; the first, of a Power whose Exponent is equal to the Years in the given Time; the second, of a Power whose Exponent is one more than the Years in the given Time: The Difference of these Roots, multiplied by the Decimal Parts in the given Time, and the Product subtracted from the first Root, will (rejecting all beyond two Decimal Places) leave the Ratio of the Rate required. *The like is to be understood in Compound Interest.*

EXAMPLE.

The Present Worth of a Legacy of 578*l.* 16*s.* 3*d.* payable at the End of three Years, at Simple Interest, is 503*l.* 6*s.* $3\frac{1}{2}$*d*,6. At Compound Interest 500*l.* *Query*, At what Rate *per Cent.* the Discount is made?

I. At

I. At Simple Intereſt.

£ s. d
578 16 3 = 578,8125
503 6 3½,6 = 503,3152
3
1509,9456*

578,8125
503,3152
75,4973
100

1509,9456*)7549,7300(5*l.* Anſwer.
7549 7280

II. At Compound Intereſt.

£ s d
578 16 3 = 578,8125
5|00)5|78,8125

$\sqrt[3]{1,157625}$(1,05 the Ratio of 5*l.* *p. Ct.* Anſwer.

1×1×1 = 1
1×1×300 = 300)157
10×10×300 = 30000)157625
5×5×5 = 125
10×30×5×5 = 7500
30000×5 = 150000
157625

CASE

CASE IV.

The Sum discounted, Present Worth, and Rate being given, to find the Time.

RULE. *First. At Simple Interest.* From the Sum discounted subtract the Present Worth, and divide the Difference by the Rectangle of the Ratio into the Present Worth: The Quotient will be equal to the Time required.

Secondly. At Compound Interest. Divide the Sum discounted by the Present Worth: The Quotient will be a Power of the Ratio whose Exponent is equal to the given Time; therefore divide the said Power and the successive Quotients continually by the Ratio until the last Quotient is 1 and the Remainder 0: The Number of those Divisions will be equal to the Time required, in Years.

N. B. When it happens that the last Quotient is greater than Unity, but less than the Ratio (which is most generally the Case) a second Operation becomes necessary; that is, Raise the Ratio to a Power whose Exponent is equal to the Number of the foregoing Divisions, which Power subtract from the Quotient arising from dividing the Sum discounted by the Present Worth; reserve the Difference. Also subtract the said Power from the next superior Power of the Ratio, and divide the Difference so found by the Difference before reserved, and add the Number of the afore-mentioned Divisions to the Quotient: That Sum will be equal to

 the

the Time required. *The same is to be observed in Compound Interest.*

EXAMPLE.

A Gentleman left a Legacy of 578*l.* 16*s.* 3*d.* which being discounted at 5*l.* *per Cent.* Simple Interest; the present Worth is 503*l.* 6*s.* 3½*d*6, at Compound Interest 500*l.* *Query*, In what Time the said Legacy is payable?

I. At Simple Interest.

L. s. d
578 16 3 = 578,8125
503 6 3½,6 = 503,3152

503,3152
,05
25,165760

25,16576)75,49730(3 Years
75,49728

II. At Compound Interest.

500)578,125
1,05 1,05

1,05)1,157625(1,1025(1,05(1
105 105 105

107 525
105 525

262
210

525
525

Here the Number of Divisions by the Ratio are 3 = the Number of Years required.

RECIPROCAL PROPORTION, is when of four Terms, the fourth is less than the second by so much as the third is greater than the first & *per* Contra. *See Inverse Propor:*

RECTANGLE, a Product.

REDUCTION, is a Rule which teaches to change or convert Money, Weight, and Measure from one Denomination to another, and still to retain the same Value.

REDUCTION ASCENDING, is the bringing of all small Names into great; as Shillings into Pounds, Quarters into Yards, Hundreds into Tons, &c. and is thus performed,

RULE, Divide the given Number by as many Units of its own Name as are equal to an Unit of the Denomination required; The Quotient will be the Answer.

EXAMPLE.

In 2469276 Pence how many Groats, Shillings and Guineas?

4)2469276 Pence
3)617319 Groats
21=7×3)205773 Shillings
7)68591(5×3=15 over
9798 Guineas

} Answer

REDUCTION DESCENDING, is the bringing of all great Names into ſmall, as Pounds into Shillings, Tons into Hundreds, &c. This admits of two Caſes.

C A S E I.

When the given Sum or Quantity conſiſts of one Denomination only.

Rule. Multiply the given Sum or Quantity by as many Units of the Denomination required as are equal to an Unit of the ſaid Sum or Quantity given: The Product will be the Anſwer.

E X A M P L E.

In 469*l.* how many Crowns, Shillings, Three-pences and Farthings?

469	Pounds	
4		
1867	Crowns	Anſwer
5		
9380	Shillings	
4		
37520	Three-pen.	
12		
450240	Farthings	

CASE

C A S E II.

When the given Sum or Quantity consists of more Denominations than one.

Rule. Reduce the greatest Denomination in the given Sum or Quantity to the same Name as that which is next inferior, (*per Case* I) and to the Result add the Number expressed in the said next inferior Denomination.* Also reduce that Sum to the same Name as its next inferior Denomination, and to the Result add the Number expressed in its corresponding Denomination; and in this Manner proceed until the Whole is finished.

E X A M P L E.

	£	s	d	
Reduce	46	11	$7\frac{1}{2}$	into Farthings
	20			
	931	Shillings		
	12			
	11179	Pence		
	4			
Answer	44718	Farthings		

REDUCTION of DECIMALS, admits of three Cases.

CASE

* The Addition is aptly performed in the Mind, during the Operation of the Multiplication.

CASE I.

To reduce a vulgar Fraction to a Decimal.

RULE. Divide the Numerator by the Denominator: The Quotient will be the Decimal required. *See Division of Decimals.*

EXAMPLE.

Reduce $\frac{7}{8}$ to a Decimal.

8)7,000

,875 Answer

N. B. Whatever Denomination the Vulgar Fraction is of, the Decimal is of the same.

CASE II.

To reduce any Sum or Quantity to a Decimal of any proposed Integer of the same Kind.

RULE. Reduce it first to a Vulgar Fraction of the proposed Integer, and then proceed as in Case I.

EXAMPLE.

Reduce 15s. to the Decimal of a £.

15s. = $\frac{15}{20}$£. 2|0)1|5,0

,75 Answer

C A S E III.

To find the Value of a Decimal Fraction in the known Parts of its Integer.

Rule. Multiply the given Decimal by as many Units of the next inferior Denomination as are equal to the Integer of the given Decimal; and continue to multiply the Decimal only of every successive Product by as many Units of the next inferior Denomination as are equal to an Unit of the last Multiplier: The integral Parts of the several Products will Express the Value required in the same Name as the respective Multipliers from which they were produced.

E X A M P L E.

Reduce ,46575 of a £ to its proper Value.

```
 ,46575                  s d
     20          Answer 9 3¾,12
 -------
 9,31500
      12
 -------
 3,78000
       4
 -------
 3,12000
 -------
```

REDUCTION of VULGAR FRACTIONS.

P R O B. I.

To reduce a simple Fraction to its lowest Terms.

Rule

Rule. Divide the greater Term by the less, and the last Divisor by the last Remainder continually, until nothing remains, then divide both Terms of the given Fraction by the last Divisor, and the corresponding Quotients will be the Terms required.

EXAMPLE.

Reduce $\frac{48}{128}$ to its lowest Terms.

```
48)128(2
   96
   --
   32)48(1
      32
      --
      16)32(2
         32
         --
```

16)$\frac{48}{128}$(=$\frac{3}{8}$ Answer

PROB. II.

To reduce a mixed Number to an improper Fraction.

Rule. Multiply the whole Number by the Denominator of the fractional Part, and to the Product add its Numerator; then place the aforesaid Denominator under the Sum, and it will constitute the Fraction required; which reduce to its lowest Terms by Case I.

N. B. To express a whole Number Fraction-wise. Place Unity for its Denominator.

EX-

EXAMPLE.

Reduce $26\frac{7}{8}$ to an improper Fraction.

$$26\times8+7=215$$

hence $26\frac{7}{8}=\frac{215}{8}$ Answer.

PROB. III.

To reduce any Sum or Quantity to the Fraction of any proposed Integer.

RULE Reduce the given Sum or Quantity to the lowest Denomination expressed therein, for a Numerator of the required Fraction; and also reduce the proposed Integer to the same Denomination for a Denominator of the same Fraction, which reduce to its lowest Terms by Prob. I.

EXAMPLE.

Reduce 6*s.* 8*d.* to the Fraction of a £ Sterling.

s d	£
6 8	1
12	20
80	20
	12
	240

hence 6*s* 8*d* $=\frac{80}{240}=\frac{1}{3}$ £ Ans.

PROB. IV.

To reduce a mixed Fraction to a simple one.

 CASE

Case I. If the upper Term be only a mixed Number.

RULE. Multiply the Integral Part of the upper Term by the Denominator of its Fractional Part; and to the Product add the Numerator of the same Part for a Numerator of the required Fraction; and also multiply the lower Term of the given Fraction by the Denominator of the aforesaid Fractional Part for a Denominator of the required Fraction, which reduce to its lowest Terms by Prob. I.

EXAMPLE.

Reduce $\frac{23\frac{3}{21}}{68}$ to a simple Fraction.

$23\times21+3=486$ New Num.
$68\times21=1428$ New Den.

hence $\frac{23\frac{3}{21}}{68}=\frac{486}{1428}=\frac{81}{238}$ Answer.

Case II. If the lower Term only be a mixed Number.

RULE. Multiply the Integral Part of the lower Term by the Denominator of its Fractional Part, and to the Product add the Numerator of the same Part for a Denominator of the required Fraction; and also multiply the Numerator of the given Fraction by the Denominator of the aforesaid Fractional Part for a Numerator of the required Fraction, which reduce to its lowest Term by Prob. I.

EX-

EXAMPLE.

Reduce $\frac{68}{23\frac{3}{21}}$ to a simple Fraction.

$23\times21+3=486$ N. Den.
$68\times21=1428$ N. Num.

hence $\frac{68}{23\frac{3}{21}}=\frac{1428}{486}=\frac{238}{81}$ Answer

Case III. If both the upper and lower Terms be mixed Numbers.

RULE. Multiply the Integral Part of the upper Term by the Denominator of its Fractional Part, and to the Product add the Numerator of the same Part, and multiply the Sum by the Denominator of the Fractional Part of the lower Term for a Numerator of the required Fraction: Then multiply the Integral Part of the lower Term by the Denominator of its Fractional Part, and to the Product add the Numerator of the same Part, and multiply the Sum by the Denominator of the Fractional Part of the upper Term for a Denominator of the required Fraction, which reduce to its lowest Terms by Problem I.

EXAMPLE.

Reduce $\frac{34\frac{2}{9}}{36\frac{7}{8}}$ to a simple Fraction. Ans. $\frac{2464}{2655}$

$$24 \times 9 + 2 \times 8 = 1744 \text{ New Num.}$$
$$36 \times 8 + 7 \times 9 = 2655 \text{ New Den.}$$

hence $= \frac{24\frac{2}{9}}{36\frac{7}{8}} = \frac{1744}{2655}$ per Problem I.

P R O B. V.

To reduce a compound Fraction to a simple one.

Rule. Reduce the Sums or Quantities, and alſo the whole and mixed Numbers to Improper Fractions, by Prob. II and III; and all the mixed Fractions to ſimple ones, by Prob. IV. Let the reduced Fractions be ſubſtituted inſtead of their Originals: Then multiply all the Numerators together for a Numerator of the required Fraction, and all the Denominators together for a Denominator of the ſame Fraction; which reduce to its loweſt Terms by Prob. I.

E X A M P L E.

Reduce $\frac{3}{4}$ of $\frac{8}{7}$ of $\frac{21\frac{2}{3}}{16}$ of $16\frac{7}{9}$ of 18 to a ſimple Fraction, Anſwer $\frac{15565}{28}$

$\frac{21\frac{2}{3}}{16} = \frac{65}{48}$ *per* Caſe I, of Prob. II.

$16\frac{7}{9} = \frac{151}{9}$ *per* Prob. III.

(Continued in the next Page.)

$18=\frac{18}{1}$ *per* Note of Prob. II.

$3\times8\times65\times151\times18=4240080$ New Num.
$4\times7\times48\times\ 9\ \times1\ =\ 12096$ New Den.

$\frac{4240080}{12096}=\frac{9815}{28}$ Answer.

PROB. VI.

To reduce an improper Fraction to its proper Terms.

Rule. Divide the Numerator by the the Denominator and the Quotient will be the Answer.

N. B. This Case proves Case II.

Reduce $\frac{215}{28}$ to its proper Terms.

$8)\frac{215}{28}(\frac{7}{8}$ Answer.

PROB. VII.

To reduce a simple Fraction from one Denomination to another.

Case I. If the given Fraction is to be reduced to a greater Denomination.

Rule. Reduce the Integer of the Fraction proposed to the same Denomination as the Fraction given, then multiply the Result by the Denominator of the said given Fraction, and place its Numerator over the Product, and it will constitute the Fraction required,

required, which reduce to its lowest Terms by Prob. I.

EXAMPLE.

Reduce $\frac{2}{9}$ of a Penny to the Fraction of a Pound sterling.

$$1£\times 20\times 12\times 9=2160$$

$$\frac{2}{2160}=\frac{1}{1080}\ per\ \text{Prob. I.}$$

$$\text{hence}\ \frac{2}{9}\,d=\frac{1}{1080}\,£\ \text{Answer.}$$

Case II. If the given Fraction is to be reduced to a less Denomination.

RULE. Reduce the Integer of the Fraction given to the same Denomination as the Fraction proposed, then multiply the Result by the Numerator of the said given Fraction, and place its Denominator under the Product, and it will constitute the Fraction required, which reduce to its lowest Terms by Prob. I.

EXAMPLE.

Reduce $\frac{1}{1080}$ of a Pound Sterling to the Fraction of a Penny.

$$1£\times 20\times 12\times 1=240$$

$$\frac{240}{1080}=\frac{2}{9}\ per\ \text{Prob. I}$$

$$\text{hence}\ \frac{1}{1080}\,£=\frac{2}{9}\,d\ \text{Answer.}$$

PROB.

P R O B. VIII.

To reduce a simple Fraction of any Terms to another Fraction of the same Value that shall have either of its Terms equal to any Number proposed.

C A S E I.

If the Denominator of the required Fraction be given.

Rule. Multiply the Denominator of the Fraction required by the Numerator of the Fraction given: Then divide the Product by the Denominator of the said given Fraction, and the Quotient will be the Numerator of the Fraction required.

E X A M P L E.

Reduce $\frac{42}{112}$ to a Fraction of the same Value, whose Denominator shall be 16.

```
112 : 42 :: 16
      16          hence 42/112 = 6/16 Ans.
     ----
     252
     42
     ----
112)672(6
    672
    ----
     ..
```

PROB.

PROB. IX.

To reduce Fractions, having different Denominators, to other Fractions of the same Value, which shall have one Denominator common to them all.

RULE. Multiply each Numerator severally, and all the Denominators, except its own, continually together for Numerators of the required Fractions: Also multiply all the Denominators continually together for a Denominator of the same Fractions.

N. B. The Sums, Quantities, whole and mixed Numbers, must be first reduced to improper Fractions by Problem II and III; and all the compound and mixed Fractions to simple ones, by Problem IV and V.

EXAMPLE.

Reduce $\frac{7}{8}$, $\frac{5}{9}$ and $\frac{4}{11}$ to other Fractions of the same Value, having a common Denomination.

$7\times9\times11=693$ New Numerators
$5\times8\times21=440$ Ditto
$4\times8\times\ 9=288$ Ditto
$8\times9\times11=792$ Com. Denominators
$\frac{693}{792}$, $\frac{440}{792}$, and $\frac{288}{792}$ Answer.

PROB. X.

To find the Value of any simple Fraction in the known Parts of its Integer.

RULE. Multiply the Numerator of the given Fraction by as many Units of the next inferior Denomination as are contained in an Unit of the Integer of the said Fraction

tion, and divide the Product by the Denominator; then multiply the Remainder by the Units of the next inferior Denomination, and divide as before; proceed thus until the lowest Denomination, and the Quotients will be the Answer in the same Denomination as their respective Multipliers.

EXAMPLE.

Reduce $\frac{547}{960}$ of a Pound Sterling to its proper Value.

```
        547
         20
     --------
96|0)1094|0(11s. 4¾d. Answer.
      96
     ----
      134
       96
     ----
   96)456(4d.
      384
     ----
       72
        4
     ----
   96)288(¾
      288
     ----
      ...
     ----
```

REMAINDER, (*in Subtraction*) the same as Difference. *In Division*, 'tis the odd, or

 what

what remains at last after all the Dividuals are brought down from the Dividend.

RESIDUAL, the same as Remainder.

RESOLVEND (*in the Extraction of Roots*) is the Number which arises from the Remainder (after Subtraction) being increased by the next Period of the given Power.

ROOT, the Root of any given Power is such a certain Number as if involved into itself as often as the Exponent of the said Power denotes; The Result will be equal to the Power itself.

RULE, certain Directions whereby any particular Operation is to be wrought.

RULE of FALSE, *see Position.*

RULE of THREE, *see single and double Rule of Three.*

RULE of THREE DIRECT, is when the Proportion is Direct.

RULE of THREE INVERSE, is when the Proportion is Inverse.

RULE of THREE in FRACTIONS, whether Vulgar or Decimal, is performed in the same Manner as that of whole Numbers; Respect being had to the Operations of the four primative Rules.

SE-

S

SECUNDANS, are the Squares of the several Terms of a continued Series of Arithmetical Progressionals, whose first Term is 0, and their common Difference 1.

SEPTENARY, of the Number 7.

SESQUIALTERAL PROPORTION, is when any Number contains another once, with an Addition of its Moiety or Half.

SESQUITERTIAN PROPORTION, is when any Number contains another once, and a third Part of it more.

SEXAGENARY ARITHMETIC, the Application of Sexagenary Numbers.

SEXAGENARY NUMBERS, are such as proceed by Sixties.

SEXAGESIMAL FRACTIONS, are such as have always 60 for their Denominators.

SIGNS, certain Symbols or Marks. *See Characters.*

SIMILAR NUMBERS, are such as may be ranged so as to represent like plane or solid geometrical Figures, and consequently such as have their Sides proportional.

SIMPLE	ADDITION, SUBTRACTION, MULTIPLICATION, DIVISION	See Addition, &c. of Integers.

SIMPLE INTEREST, is the Profit arising from any Sum of Money in any Time, at a certain Rate *per Cent. per Ann.*

 CASE

CASE I.

To find the Interest of any Sum for one Year, at any proposed Rate *per Cent.*

RULE. Multiply the given Sum by the Rate *per Cent.* and divide the Product by 100: The Quotient will be the Answer.

Otherwise thus. Divide the given Sum by 5, and the Quotient thence arising by such aliquot Parts of 20*l.* as are equal to the proposed Rate: The Sum of the Quotients arising from the Division by the aliquot Parts will be the Interest required.

EXAMPLE.

What is the Interest of 357*l.* 10*s.* for one Year, at 5*l. per Cent.*

```
£   s
357 10
     5
---------
17|87 10
   20
---------
17|50
   12
---------
 6|00
```

Answer £ 17 s 17 d 6

Or thus,

```
         £   s
      5)357  10
|£|  |   |------
|5|  |¼ |  71 10
|    |   |---------
        £ 17 17 6 Answer as before
```

This

This being understood the Interest for any other Time may be found by the following Proportion. *viz.*

As one Year is to the Interest of the given Sum for one Year, so is the Time proposed to the Time required. But this and the foregoing Case are comprised in the ensuing general RULE.

Multiply the Rectangle of the Principal into the Time by the Ratio: The Product will be the Interest required.

EXAMPLE.

What is the Interest of 430*l.* 10*s.* for $3\frac{1}{4}$ Years at 4*l.* *per Cent. per Annum?*

£ s		
430 10	=	430,5
$3\frac{1}{4}$ Years	=	3,25
		21525
		8610
		12915
		1399,125
		,04
		55,96500 = 55 £ 19 s $3\frac{1}{2}$,4 d Answer

CASE II.

The Principal, Rate, and Time, being given to find the Amount.

RULE. Multiply the Rectangle of the Principal

Principal into the Time by the Ratio, and to the Product add the Principal: The Sum will be the Amount.

EXAMPLE.

What is the Amount of 460*l.* it having been at Interest 3 Years, at 5*l. per Cent. per Annum?*

£
460
3
1380
,05
69,00
460,
£529 Answer

CASE III.

The Amount, Rate, and Time being given, to find the Principal.

RULE. To Rectangle of the Time into the Ratio add an Unit, and with that Sum divide the Amount: The Quotient will be equal to the Principal.

EXAMPLE.

What Principal will amount to 529*l* in 3 Years, at 5*l. per Cent. per Annum.*

,05

```
      ,05
        3
     -----
      ,15
     1,0
    -----                 £.
1,15)529,00(460 Answer
      460
      ---
       690
       690
       ---
         0
```

CASE IV.

The Principal, Time, and Amount, being given, to find the Rate.

RULE. From the Amount subtract the Principal; multiply the Difference by 100, and divide the Product by the Rectangle of the Principal into the Time: The Quotient will be equal to the Time.

EXAMPLE.

At what Rate *per Cent. per Annum* will 460*l.* amount to 529*l.* in 3 Years?

529

£	
529	460
460	3
69	1380*
100	

138|0*)690|0(5 Answer £
690

CASE V.

The Principal, Rate, and Amount, being given, to find the Time?

RULE. From the Amount subtract the Principal, and divide the Difference by the Rectangle of the Principal into the Ratio: The Quotient will be equal to the Time.

EXAMPLE.

In what Time will 460*l.* amount to 529*l.* at 5*l. per Cent. per Annum*?

529	460
460	,05
23*)69(3 Yrs. Ans.	23,00*
69	

SIMPLE FRACTIONS, are such as consist of two Terms only, and they both Integral.

SINGLE POSITION, is when one Supposition only

only is required in order to a Solution of the Question proposed.

Rule. Suppose a Number or Quantity at Pleasure, and take it as if granted, for the true Number or Quantity sought, and and proceed therewith according to the Tenor of the Question as tho' you would prove the same: *then*, As the Result is to the supposed Number or Quantity, so is the given Number or Quantity to the Number or Quantity required.

EXAMPLE.

A Father left 1000*l.* to be divided in the following Manner to his three Sons, to *A* he left three Times as much as he did to *B*, and to *B* he left twice as much as he did to *C*: *Query*, The Share of each?

		£	
Suppose *C*'s Share	—	10	*per* Quest.
Then *B*'s would be	—	20	
And *A*'s	—	60	

The Sum £90

But this should have been equal to 1000*l.* therefore

	£		£		£
As	90	:	10	::	1000
					10

9|0)1000|0

	£	s	d		
Consequently	111	2	$2\frac{1}{2},\frac{2}{3}$	=	*C*'s Share
	222	4	$5\frac{1}{4},\frac{1}{3}$	=	*B*'s Share
	666	13	4	=	*A*'s Share
Poof	1000	0	0		

SINGLE RULE of THREE, so called from having three Terms given, two in a Supposition and one in a Demand, to find a fourth, either in a direct or in an Inverse Proportion.

To State a Question.

Let the Term in the Demand possess the last Place towards the right Hand, and let its corresponding Term in the Supposition possess the first Place towards the left Hand, and the remaining Term the middle Place.

To Work a Question.

Reduce the first and third Terms to one and the same Denomination, and the second to the lowest Denomination mentioned therein; then if the Proportion be direct, multiply the second and third Terms together, and divide the Product by the first; but if the Proportion be Inverse, multiply the first and second Terms together, and divide the Product

Product by the third; The Quotient in either Case will be the Answer to the Question in the same Denomination as the second Term was reduced to.

EXAMPLE.

If 26 lb of Sugar cost 13*s*. 9½, what will 14Cwt. cost at the same Rate?

```
lb    s.  d.       Cwt.
26 .. 13  9½  ::  14
      12            4
     ----         ----
      165           56
        4           28
     ----         -----
      662          448
     ====          112
                 ------
                  1568
                   662
                 ------
                  3136
                 9408
                9408
              ---------            4
26)1038016(39923(18/26)
   78           --------
   ---          12)9980 3/4 (18/26)
   258            -----------
   234          2|0)83|1  8 3/4, 18/26
   ---              ----------------
   240            £41  11  8 3/4, 18/26  Answer
   234              ----------------
```

(Continued in the next Page)

```
61
52
——
96
78
——
81
==
```

If 14 Men can perform a Piece of Work in 10 Days, how many Men can perform the same in 7 Days?

```
D.   M.   D.
10 .. 14 :: 7
     10
   ————
  7)140
   ————
    20 Answer
    ==
```

SOLID NUMBERS, are such as are produced from the Multiplication of plane Numbers by some other Numbers.

SPECIOUS ARITHMETIC, is performed by Letters or Characters, and takes the Quantity sought as if granted, and by means of one or more Quantities given, proceeds by Consequence 'till the Quantity at first only supposed to be known, or some Power of it, is found to be equal to some Quantity or Quantities known, and consequently itself known likewise.

SQUARE NUMBERS, are such as contain the second

ſecond Power of their Roots. The Product of any Number multiplied by itſelf is a ſquare Number.

SQUARE ROOT, is the Side of a ſquare Number. *See Extraction of Roots.*

SQUARING DIMENSIONS, (commonly called Croſs Multiplication) is a Rule whereby Carpenters, Painters, Glaziers, &c. eſtimate the Quantity of their Work; and in order to this obſerve that,

Twelfths	multiplied by	Twelfths	Produce	Seconds*
		Inches		Primes
		Feet		Twelfths
Inches	multiplied by	Twelfths	Produce	Primes
		Inches		Twelfths
		Feet		Inches
Feet	multiplied by	Twelfths	Produce	Twelfths
		Inches		Inches
		Feet		Feet

*12 Seconds	make	1 Prime
12 Primes		1 Twelfth
12 Twelfths		1 Inch
12 Inches		1 Foot

See Duodecimals.

Things

Things being thus stated, the general Rule is as follows.

Place the least Quantity under the greater, according to the Rule given in Addition of Money, &c. draw a Line under the same, and multiply the Multiplicand by every Denomination severaly of the Multiplier, as in Multiplication of Money, &c. respect being had to the foregoing Table of Observations; add the several Products together, and their Sum will be the Answer required.

EXAMPLE.

How many square Feet are contained in a Piece of Wainscot that is 3 Ft. 2 In. high, and 11 Ft. 7 In. long?

Ft.	In.	
11	7	
3	2	
1	11	2
34	9	
36 :	8 :	2 Answer

STERLING, a Name or Denomination by which the current and lawful Money of *England* is distinguished from that of any other Country or Place.

SUBDIVIDE, a dividing the Parts of that which has already been divided.

SUBDUCTION, Subtraction, Abatement.

SUB-

SUBDUPLE PROPORTION, when any Number is contained exactly twice in another, it is said to be in Subduple Proportion.

SUBMULTIPLE NUMBERS, are such as are contained in others, exactly, any Number of Times; an Aliquot Part is the Submultiple of its Whole.

SUBMULTIPLE PROPORTION, the Contrary of Multiple Proportion, which see.

SUBSESQUIALTERAL PROPORTION, the Contrary to Sesquialteral Proportion.

SUBSUPER *particular* PROPORTION, the contrary to Super-*particular* Proportion.

SUBTRACTION, is the taking a less Number, Sum, or Quantity, from a greater, so as to discover their Difference.

SUBTRACTION of DECIMALS, is performed in the same Manner as that of Integers, regard being had (as in their Addition) to the placing of the several Figures according to their respective Values.

EXAMPLE.

From	,2768	,069476
Take	,0724	,0076
Remains	,2044	,061876

From	126,706	12,0076
Take	97,03	,72
Remains	29,676	11,2876

SUBTRACTION of INTEGERS, is the finding the Difference between any two Numbers that

that are of one and the same Denomination. The general RULE is as follows.

Place the Subtrahend under the Minuend as in Addition of Integers; draw a line under the same; then begin at the Place of Units, and subtract the lower Figure from the upper Figure; set the Remainder, if any, (if not any, a Cypher) under its own Denomination, below the Line drawn;* proceed thus in the Place of Tens, and also in that of the Hundreds, &c. until the Whole is finished, and it will give the Difference required.

N. B. If either or of both the Numbers are affected with Signs, change the Sign of the Subtrahend to its contrary, and add the Numbers together, according to the Note in Addition of Integers: Their Sum will be equal to the Difference required.

EXAMPLE.

From	46096	762700
Take	19476	90274
Diff.	26620	672426

From

* If in any Part of the Process the upper Figure should be less than the lower Figure, borrow Ten; subtract the lower Figure from the Number borrowed, and to the Difference add the upper Figure, and place the Sum respectively under the Line, pay that which was borrowed by adding one to the Figure in the next succeeding Place, and proceed as above directed.

From	+26927	+26927
Take	+93205	−93205
	Difference	−66278

From	+36009	+36009
Take	−41230	+41230
	Difference	+77239

To Prove Subtraction.

RULE. Add the Difference to the Subtrahend: The Sum (if the Work is just) will be equal to the Minuend.

Or, Subtract the Difference from the Minuend: The Difference so found (if the Work is just) will be equal to the Subtrahend.

SUBTRACTION of MONEY, WEIGHT and MEASURE, is the finding the Difference between any two Sums or Quantities that are of more Denominations than one, but all subject to the same principal Integer.

The RULE is as follows.

Place the Subtrahend under the Minuend, as in Addition; draw a Line under the same; then subtract the lower Number, in the least Denomination, from the upper Number (as in Subtraction of Integers) and set the Difference under its own Denomination below

 the

the Line drawn.* Proceed in like Manner with every succeeding Denomination until the whole is finished, and it will give the Difference required.

EXAMPLE.

	£	s	d	Cwt.	Q.	lb
From	126	12	9	26	1	$14\frac{1}{2}$
Take	69	14	$3\frac{1}{4}$	12	0	18
Remains	56	18	$5\frac{3}{4}$	14	0	$24\frac{1}{2}$

SUBTRACTION OF VULGAR FRACTIONS, admits of two Cases.

First, When both the Subtrahend and Minuend are simple Fractions, and of the same Denomination; that is, Fractions of the same Integer.

Secondly, When the Subtrahend and Minuend are Fractions of different Denominations; that is, Fractions of different Integers, but of the same Kind or Specie.

RULE. *In the first Case*, Reduce the Fractions

* If in any Denomination the lower Number be greater than the upper Number, borrow as many Units of its own Name as are equal to an Unit of the next succeeding Denomination; subtract the lower Number from the Number borrowed, and to the Difference add the upper Number, and set the Sum respectively under the Line: Pay that which was borrowed, by adding one to the Figure in the Unit's Place of the lower Number in the next succeeding Denomination, and proceed as above directed.

tions to a common Denominator, and subtract the Numerator of the Subtrahend from the Numerator of the Minuend, subscribe the common Denominator under the Difference, and it will constitute a Fraction expressing the Difference required.

In the second Case, Reduce the Fractions to the same Denomination, and then proceed as in Case I.

N. B. If either or both the Minuend and Subtrahend consist of more Parts than one, the Parts of each respectively must be added together (*per Addition of Vul: Fractions*) And in such Case the Difference of their Totals will be the Difference required.

When whole or mixed Numbers occur, reduce them to improper Fractions.

Or, *in either Case*, Reduce the Fractions to their equivalent Values in the known Parts of their Integers, and then proceed as in whole Numbers.

EXAMPLE.

From $\frac{7}{8}$ subtract $\frac{2}{5}$.

$\left.\begin{matrix} 7\times5 = 35 \\ 8\times2 = 16 \end{matrix}\right\}$ N. Num.

Diff. 19

$8\times5 = 40$ C. Den.

hence $\frac{7}{8} - \frac{2}{5} = \frac{19}{40}$ the Diff. required.

 From

From $\frac{3}{4}$ take $\frac{7}{8}$ of $\frac{1}{3}$.

$\frac{7}{8} \times \frac{1}{3} = \frac{7}{24}$ (*per Prob: 5 Red.*)

$\frac{3}{4}, \frac{7}{24}$ $\left.\begin{array}{l} 3 \times 24 = 72 \\ 4 \times 7 = 28 \end{array}\right\}$ N. Num.

Diff. 44

$4 \times 24 = 96$ C. Den.

hence $\frac{3}{4} - \frac{7}{8}$ of $\frac{1}{3} = \frac{44}{96} = \frac{11}{24}$ the Diff. required.

From $\frac{4}{5}$ of a £ Sterling subtract $\frac{7}{9}$ of 12 Shillings.

$12s. = \frac{12}{1}s.$ *per Note Prob. II. Red.*

$\frac{7}{9} \times \frac{12}{1} = \frac{84}{9}s.$ *Per Prob. V. Red.*

$\frac{84}{9}s. = \frac{84}{180}$£ *Per Case I. Prob. VII. Red.*

$\frac{4}{5}, \frac{84}{180}$ $\left.\begin{array}{l} 4 \times 180 = 720 \\ 84 \times 5 = 420 \end{array}\right\}$ N. Num.

Diff. 300

$5 \times 180 = 900$ C. Den.

hence $\frac{4}{5}$£ $- \frac{7}{9}$ of 12s. $= \frac{300}{900}$£ $= \frac{1}{3}$£ $= 6s\ 8d.$ the Difference required.

Proof by the general Rule.

	s.	d.	
$\frac{4}{5}$ £ =	16	0	Prob. 10.
$\frac{7}{9}$ of 12s. =	9	4	
Diff.	6	8	as above.

SUBTRAHEND, the Number, Sum or Quantity, that is to be taken or subtracted from the Minuend.

SUBTRIPLE PROPORTION, when any Number is contained in another just three Times, it is said to be in Subtriple Proportion.

SUM, any Quantity of Money, also the Aggregate or Total, resulting from the Addition of two or more Numbers, &c.

SUMMARY ARITHMETIC, (in Fluxions) is the Method of finding the flowing Quantity.

SUPERBIPARTIENT NUMBER, is such as will not divide another into two equal Parts, or that which is not the exact half of another.

SUPERPARTICULAR PROPORTION, when any Number is contained once in another, and leaves an Unit remaining, it is said to be in Superparticular Proportion.

SUPERPARTIENT PROPORTION, when one Number is contained once in another, and leaves any Number of aliquot Parts remaining, it is said to be in Superpartient Proportion.

SUPERTRIPARTIENT NUMBER, is such as will not divide another Number into three equal Parts without a Fraction; or, it is that which is not the exact one third Part of another.

SUPPOSITION, *(in the Rule of Three)* is that Part of a Proposition which contains the Terms expressing the Rate or Proportion of the Term required. The remaining Part of a Proposition after the Demand is separated from it.

SUPPUTATION, a casting up, reckoning.

SURD NUMBERS, are such as have no expressible Root.

SUR-

SURSOLID NUMBERS, are ſuch as contain the fifth Power of their Roots.

SUTTLE WEIGHT, is what remains after the Tare is deducted from the Groſs Weight.

SYMBOLS, ſee Characters.

SYMETRAL NUMBERS, ſee Commenſurable Numbers.

T.

TABLES, ſhewing the Par of Exchange between *London* and the principal Places of the known World.

I. FRANCE.

						s.	d.
12	Deniers	make	1	Sol	equal to	0	$0\frac{9}{20}$
20	Sols		1	Livre		0	9
6	Livres		1	Gros Ecu*		4	6

Sterling at Par.

N. B. They keep their Accounts in Livres, Sols, and Deniers.

The *Gros* Ecu paſſes in *France* for the ſame Value that a Quarter of a Guinea does in *England*, and the other Specie in the like Proportion.

II.

---

* Or Crown. There is another Crown which is more generally ſpoke of in *France*, and is equal in Value to half the former.

II. SPAIN.

				s.	d.	
34 Maravedies	make	1 Rial	equal to	0	6¾	
[illegible] Rials		1 Piastre *		[illegible]	6	Sterling
10 Rials		1 Dollar §		[illegible]	[illegible]	at Par.

N. B. They keep their Accounts in Dollars, Rials and Maravedies.

III. ITALY.

				s.	d.	
12 Deniers	make	1 Sol	equal to	0	[illegible]	
20 Sols		1 Livre		0	9	
5 Livres		1 Piastre of *Genoa*		3	[illegible]	
6 Livres		1 Ditto *Leghorn*		4	6	Sterling at Par

ALSO

6 Solidii	make	1 Gross	equal to	0	2½	Sterling
24 Grosses		1 Ducat		5	0	at Par.

N. B. They keep their Accounts as in *France*.

IV. PORTUGAL.

1000 Reas [illegible] at Par.

N. B. They keep their Accounts in Reas.

---

* Or Piece of Eight. § Or Piece of Eight.

V. HOLLAND, FLANDERS, and GERMANY.

				s.	d.
8 Pennings	make	1 Groat	equal	0	1
2 Groats		1 Stiver		0	2
20 Stivers		1 Guilder or Florin		3	4

Sterl. at Par

A L S O.

				l.	s.	d.
6 Stivers	make	1 Schelling	eql.	0	1	0
20 Schellings		1 Pound Flem:		1	0	0

Sterling at Par.

N. B. Some keep their Accounts in Pounds, Shillings, and Pence, as in *England*; others in Guilders, Stivers and Pennings.

⁂ 34*s.* 4*d.* Flemish is equal to 1*l.* Sterling at Par.

VI. IRELAND.

1*l.* Sterling is equal to 1*l.* 1*s.* 8*d.* Irish, and 1*s.* Sterling is equal to 14*d.* Irish.

TABLES, shewing the Weight and Value of Foreign Coins, as adjusted by the Assayers of the Mint, and rated as Bullion.

I. GOLD

I. GOLD COINS.

	Weight.		Value.		
	pwts.	gr.	l.	s.	d.
French Lewis	4	8	0	17	4
Holland Rider	6	10	1	5	9
Hungary Ducat	2	6	0	9	8
Spanish Pistole	4	8	0	17	4
Flanders Albertus	3	8	0	13	0
Double Sovereign of Flanders	6	3½	1	8	6
Italian Pistole	4	6	0	16	7
Gilder of Porthono	2	3	0	6	10
Gilder of Matthias Emperor	2	3	0	7	2
Gilder of Noremburg	2	3	0	7	1
Half Cardinal Angel	1	20	0	6	4
Chickeen of Venice	2	7	0	9	7
A Danish Coin, with a Crown on one Side of it	3	20	0	15	4
Moidore	6	22	1	7	0
Johannes	9	6	1	16	0

With their Halves, Quarters, *&c.*

II. SILVER COINS.

	Weight.			Value.		
		pwts.	gr.	s.	d.	f.
Holland Dollar	0	18	5	4	4	0
Lyon Dollar	0	17	18	3	4	2
Duckatoon of Flanders	1	0	22	5	4	0
Rix Dollar of the Empire	0	18	15	4	5	3
Mexico Royal	0	17	12	4	4	2
Seville Royal	0	17	12	4	4	3
Old Cardecue	0	6	3½	1	6	1
French Lewis	0	17	11	4	4	1
Double Milrez of Portugal	0	14	4	3	6	1
Single Milrez of Portugal	0	7	2	1	9	0
St. Mark of Venice	0	10	4	2	6	0

		Weight.		Value.		
		pwts.	gr.	s.	d.	f.
Double Dutch Stiver —	0	1	0	0	1	3
Cross Dollar —— —	0	18	0	4	2	1
Zealand Dollar ——	0	13	0	2	7	0
Old Phillip Dollar ——	1	2	0	5	0	0
Ferdinando Dollar, 1623	0	18	6	4	3	0
Pr. of Orange Dollar, 1624	0	18	6	4	3	3
Danish Dollar, 1620 —	0	13	0	2	11	1
Portugal Testoon ——	0	5	0	1	2	3
New Qr. of French Lewis	0	4	9	1	1	0

TABLE, shewing the Value and Weight of English Coins.

	pwt.	gr.	l.	s.	d.
Guinea	5	9	1	1	0
½ ditto	2	16½	0	10	6
¼ ditto	1	8¼	0	5	3

N. B. 4 Farthings make 1 Penny.
12 Pence —— 1 Shilling.
20 Shillings —— 1 Pound.

A

TABLE, ſhewing the ſpecific Gravity of divers Things.

A Cubick Inch of	*Ounces Tr.*		*Ounces Avr.*
Fine Gold is	10,359273	=	11,365602
Standard Gold,	9,962625	=	10,9304 2
Quick Silver,	7,384411	=	8,1017 3
Lead,	5,984010	=	6,553885
Fine Silver,	5,850035	=	6,418324
Standard Silver,	5,556769	=	6,096569
Roſe Copper,	4,747121	=	5,208369
Plate Braſs,	4,404273	=	4,832116
Caſt Braſs,	4,272409	=	4,630300
Steel,	4,142127	=	4,544505
Common Iron,	4,031361	=	4,422979
Block Tin,	3,861519	=	4,236638
Fine Marble,	1,429411	=	1,568859
Common Glaſs,	1,360841	=	1,493037
Alabaſter,	0,988456	=	1,084477
Dry Ivory,	0,962083	=	1,055542
Dry Box-wood	0,543282	=	0,596057
Sea Water,	0,542742	=	0,594894
Comm^{n} clear Water,	0,527458	=	0,578697
Red Wine,	0,523766	=	0,574646
Proof Spirits or Brandy,	0,489268	=	0,536796
Sound dry Oak	0,489008	=	0,536369
Lintſeed Oil,	0,491591	=	0,539345
Oil Olive,	0,481569	=	0,528350

TABLE of POWERS. *See the following Page.*

Roots. – – – –	1	2	3	4	5	6	7	8	9
Squares, – – –	1	4	9	16	25	36	49	64	81
Cubes, – – –	1	8	27	64	125	216	343	512	729
Biquadrates, –	1	16	81	256	625	1296	2401	4096	6561
Surfolids – –	1	32	243	1024	3125	7776	16807	32768	59049
Square Cubes –	1	64	729	4096	15625	46656	117649	262144	531441
Second Surfolids	1	128	2187	14384	78125	279936	823543	2097152	4782969
Biquadrates ſqurd.	1	256	6561	65536	390625	1679616	5764801	16777216	43046721
Cubes cubed, –	1	512	19683	262144	1953125	10077696	40353607	134217728	387420489
Surfolids ſquared	1	1024	59049	1048576	9765625	60466176	282475249	1073741824	3486784401
Third Surfolids –	1	2048	177147	4194304	48828125	362797056	1977326743	8589934592	313810 9609
Square Cubes ſqrd.	1	4096	531441	16777216	244140625	2176782336	13841287201	68719476732	282429536481

TABLE of ALIQUOT PARTS.

Of a £. s.	d.		
10		is	½
6	8	—	⅓
5	0	—	¼
4	0	—	⅕
3	4	—	⅙
2	6	—	⅛
2	0	—	$\frac{1}{10}$
1	8	—	$\frac{1}{12}$

Of a Shill. d.		
6	is	½
4	—	⅓
3	—	¼
2	—	⅙
1½	—	⅛
1	—	$\frac{1}{12}$

Of a Ton. Cwt.		
10	is	½
5	—	¼
4	—	⅕
2½	—	⅛
2	—	$\frac{1}{10}$

Of an hndrd. qrs.	lb		
2 or	56	is	½
1 or	28	—	¼
	16	—	$\frac{1}{7}$
	14	—	⅛

Of a Quart.			
14	—	—	½
7	—	—	¼
4	—	—	$\frac{1}{7}$
3½	—	—	⅛

TABLE of CIRCULAR MEASURE.

Seconds	Minutes	Degrees	Signs	Circle
60	1	—	—	—
3600	60	1	—	—
108000	1800	30	1	—
1296000	21600	360	12	1

According to this Meaſure Aſtronomers compute the Motion of the Celeſtial Bodies.

TA-

TABLE, shewing the Probabilities of Life in *London*, according to the learned Dr. *Price*.

Ages.	Persons living.	Decr. of Life.	Ages.	Persons living.	Decr. of life	Ages.	Persons living.	Decr. of life
0	1518	486	31	404	9	62	132	7
1	1032	200	32	395	9	63	125	7
2	832	85	33	386	9	64	118	7
3	747	59	34	377	9	65	111	7
4	688	42	35	368	9	66	104	7
5	646	23	36	359	9	67	97	7
6	623	20	37	350	9	68	90	7
7	603	14	38	341	9	69	83	7
8	589	12	39	332	10	70	76	6
9	577	10	40	322	10	71	70	6
10	567	9	41	312	10	72	64	6
11	558	9	42	302	10	73	58	5
12	549	8	43	292	10	74	53	5
13	541	7	44	282	10	75	48	5
14	534	6	45	272	10	76	43	5
15	528	6	46	262	10	77	38	5
16	522	7	47	252	10	78	33	4
17	515	7	48	242	9	79	29	4
18	508	7	49	233	9	80	25	3
19	501	7	50	224	9	81	22	3
20	494	7	51	215	9	82	19	3
21	487	8	52	206	8	83	16	3
22	479	8	53	198	8	84	13	2
23	471	8	54	190	7	85	11	2
24	463	8	55	183	7	86	9	2
25	455	8	56	176	7	87	7	2
26	447	8	57	169	7	88	5	1
27	439	8	58	162	7	89	4	1
28	431	9	59	155	8	90	3	1
29	422	9	60	147	8			
30	413	9	61	139	7			

TABLE, ſhewing the preſent Worth of one Pound Annuity for any Number of Years not exceeding 100.

Yr	3 per Ct.	3½ pr Ct.	4 per Ct.	5 per Ct.	6 per Ct.
1	.9708	.9662	.9615	.9523	.9433
2	1.9133	1.8997	1.8860	1.8594	1.8333
3	2.8286	2.8016	2.7750	2.7232	2.6730
4	3.7170	3.6731	3.6298	3.5459	3.4651
5	4.5797	4.5151	4.4518	4.3294	4.2123
6	5.4971	5.3286	5.2421	5.0756	4.9173
7	6.2302	6.1145	6.0020	5.7863	5.5823
8	7.0196	6.8740	6.7327	6.4632	6.2097
9	7.7861	7.6077	7.4353	7.1078	6.8016
10	8.5302	8.3166	8.1108	7.7212	7.3600
11	9.2526	9.0015	8.7604	8.3064	7.8868
12	9.9540	9.6633	9.3850	8.8632	8.3838
13	10.6349	10.3027	9.9856	9.3935	8.8526
14	11.2960	10.9205	10.5631	9.8986	9.2949
15	11.9379	11.5174	11.1183	10.3796	9.7122
16	12.5611	12.0941	11.6522	10.8377	10.1058
17	13.1661	12.6513	12.1656	11.2740	10.4772
18	13.7535	13.1897	12.6592	11.6895	10.8276
19	14.3238	13.7098	13.1339	12.0853	11.1581
20	14.8774	14.2124	13.5903	12.4622	11.4699
21	15.4150	14.6980	14.0291	12.8211	11.7640
22	15.9389	15.1671	14.4511	13.1630	12.0415
23	16.4436	15.6204	14.8568	13.4885	12.3033
24	16.9355	16.0584	15.2469	13.7986	12.5503
25	17.4131	16.4815	15.6220	14.0939	12.7833

Continued in the following Page.

Yr	3 per Ct.	3½ pr Ct.	4 per Ct.	5 per Ct.	6 per Ct.
26	17.8768	16.8904	15.9827	14.3751	13.0031
27	18.3270	17.2854	16.3295	14.6430	13.2105
28	18.7641	17.6670	16.6630	14.8981	13.4061
29	19.1884	18.0358	16.9837	15.1410	13.5907
30	19.6004	18.3920	17.2920	15.3724	13.7648
31	20.0004	18.7363	17.5884	15.5928	13.9290
32	20.3887	19.0689	17.8735	15.8026	14.0840
33	20.7657	19.3902	18.1476	16.0025	14.2302
34	21.1318	19.7007	18.4111	16.1929	14.3681
35	21.4872	20.0007	18.6646	16.3741	14.4982
36	21.8322	20.2905	18.9082	16.5468	14.6209
37	22.1672	20,5705	19.1425	16.7112	14.7367
38	22.4924	20.8411	19.3678	16.8678	14.8460
39	22.8082	21.1025	19.5844	17 0170	14.9490
40	23.1147	21.3551	19.7927	17.1590	15.0462
41	23.4124	21.5991	19.9930	17.2943	15.1380
42	23.7013	21.8349	20.1856	17.4232	15.2245
43	23 9819	22.0627	20.3707	17.5459	15.3061
44	24.2542	22.2828	20.5488	17.6627	15.3831
45	24.5187	22.4955	20.7200	17.7740	15.4558
46	24.7754	22.7009	20.8846	17.8800	15.5243
47	25.0247	22.8994	21.0429	17.9810	15.5890
48	25.2667	23.0912	21.1951	18.0771	15.6500
49	25.5016	23.2766	21.3414	18.1687	15.7075
50	25.7297	23.4556	21.4821	18.2559	15.7618
51	25.9512	23.6286	21.6174	18.3389	15.8130
52	26.1662	23.7958	21.7475	18.4180	15.8613
53	26.3749	23.9573	21.8726	18.4934	15.9069
54	26.5776	24.1133	21.9929	18.5651	15.9499
55	26.7744	24.2641	22.1086	18.6334	15.9905

Continued in the following Page.

Yr	3 per Ct.	3½ pr Ct.	4 per Ct.	5 per Ct.	6 per Ct.
56	26.9654	24.4097	22.2198	18.6985	16.0288
57	27.1510	24.5504	22.3267	18.7605	16.0649
58	27.3309	24.6864	22.4295	18.8195	16.0989
59	27.5058	24.8178	22.5284	18.8757	16.1311
60	27.6755	24.9447	22.6234	18.9292	16.1614
61	27.8403	25.0674	22.7148	18.9802	16.1900
62	28.0003	25.1859	22.8027	19.0288	16.2170
63	28.1556	25.3004	2.8872	19.0750	16.2424
64	28.3064	25.4110	22.9685	19.1191	16.2664
65	28.4528	25.5178	23.0466	19.1610	16.2891
66	28.5950	25.6211	23.1218	19.2010	16.3104
67	28.7330	25.7209	23.1940	19.2390	16.3306
68	28.8670	25.8173	23.263	19.2753	16.3496
69	28.9971	25.9104	23.3302	19.3098	16.3676
70	29.1234	26.0004	23.3945	19.3426	16.3845
71	29.2460	26.0873	23.4562	19.3739	16.4005
72	29.3650	26.1713	23.5156	19.4037	16.4155
73	29.4806	26.2525	23.5727	19.4321	16.4297
74	29.5928	26.3309	23.6276	19.4592	16.4431
75	29.7018	26.4067	23.6804	19.4849	16.4558
76	29.8076	26.4799	23.7311	19.5094	16.4677
77	29.9102	26.5506	23.7799	19.5328	16.4790
78	30.0099	26.6190	23.8268	19.5550	16.4896
79	30.1067	26.6850	23.8720	19.5762	16.4996
80	30.2007	26.7488	23.9153	19.5964	16.5091
81	30.2920	26.8104	23.9571	19.6156	16.5180
82	30.3805	26.8700	23.9972	19.6339	16.5264
83	30.4665	26.9275	24.0357	19.6514	16.5343
84	30.5500	26.9831	24.0728	19.6680	16.5418
85	30.1311	27.0368	24.1085	19.6838	16.5489

 Continued in the following Page.

Yr	3 per Ct.	3½ pr Ct.	4 per Ct.	5 per Ct.	6 per Ct.
86	30.7098	27.0887	24.1428	19.6988	16.5556
87	30.7862	27.1388	24.1757	19.7132	16.5618
88	30.8604	27.1873	24.2074	19.7268	16.5678
89	30.9324	27.2341	24.2379	19.7398	16.5734
90	31.0024	27.2793	24.2672	19.7522	16.5786
91	31.0703	27.3230	24.2954	19.7640	16.5836
92	31.1362	27.3652	24.3225	19.7752	16.5883
93	31.2002	27.4060	24.3486	19.7859	16.5928
94	31.2623	27.4454	24.3736	19.7961	16.5969
95	31.3226	27.4835	24.3977	19.8058	16.6009
96	31.3812	27.5203	24.4209	19.8151	16.6046
97	31.4380	27.5558	24.4431	19.8239	16.6081
98	31.4932	27.5902	24.4646	19.8323	16.6114
99	31.5468	27.6234	24.4852	19.8403	16.6145
100	31.5989	27.6554	24.5050	19.8479	16.6175
Perpetuit.	33.3333	28.5714	25.0000	20.0000	16.6666

End of the Table.

TABLE, shewing the present Worth of 1*l.* payable at the End of any Number of Years not exceeding 100.

	3 per Ct.	3½ pr Ct.	4 per Ct.	4½ pr Ct.	5 per Ct.	6 per Ct.
1	,970874	,966184	,961538	,956938	,952381	,943396
2	,942596	,933518	,924556	,915730	,907029	,889996
3	,915142	,901943	,888996	,876297	,863838	,839619
4	,888487	,871442	,854804	,838561	,822702	,792094
5	,862609	,841973	,821927	,802451	,783526	,747258
6	,837484	,813501	,790315	,767896	,746215	,704961
7	,813092	,785991	,759918	,734828	,710681	,665057
8	,789409	,759412	,730690	,703185	,676839	,627412
9	,766417	,733731	,702587	,672904	,644609	,591898
10	,744094	,708919	,675564	,643928	,613913	,558395
11	,722421	,684946	,649581	,616199	,584679	,526788
12	,701380	,661783	,624597	,589654	,556837	,496969
13	,680951	,639404	,600574	,564272	,530321	,468839
14	,661118	,617782	,577475	,539973	,505068	,442301
15	,641862	,596891	,555265	,516720	,481017	,417265
16	,623167	,576706	,533908	,494469	,458112	,393646
17	,605016	,557204	,513373	,473176	,436297	,371364
18	,587395	,538361	,493628	,452800	,415521	,350344
19	,570286	,520156	,474642	,433302	,395734	,330513
20	,553676	,502566	,456387	,414643	,376889	,311805
21	,537549	,485571	,438834	,396787	,358942	,294155
22	,521893	,469151	,421955	,379701	,341850	,277505
23	,506692	,453286	,405726	,363350	,325571	,261797
24	,491934	,437957	,390121	,347703	,310068	,246979
25	,477606	,423147	,375117	,332731	,295303	,232999
26	,463695	,408838	,360689	,318402	,281241	,219810
27	,450189	,395012	,346817	,304691	,267848	,207368
28	,437077	,381654	,333477	,291571	,255094	,195630
29	,424346	,368748	,320641	,279015	,242946	,184557
30	,411987	,356278	,308319	,267000	,231377	,174110
31	,399987	,344230	,296460	,255502	,220359	,164255
32	,388337	,332590	,285058	,244500	,209866	,154957

 Continued in the following Page.

	3 per Ct.	3½ pr Ct.	4 per Ct.	4½ pr Ct	5 per Ct.	6 per Ct.
33	,377026	,321343	,274094	,233971	,199873	,146186
34	,366045	,310476	,163552	,223896	,190355	,137912
35	,355383	,299977	,253415	,214254	,181290	,130105
36	,345032	,289833	,243669	,205028	,172657	,122741
37	,334983	,280032	,234297	,196199	,164436	,115793
38	,325226	,270562	,225285	,187750	,156605	,109239
39	,315754	,261413	,216621	,179665	,149148	,103056
40	,306557	,2525 2	,208289	,171929	,142046	,097222
41	,297628	,244031	,200278	,164525	,135282	,091719
42	,288959	,235779	,192575	,157440	,128840	,086527
43	,280543	,227806	,185168	,150663	,122704	,081630
44	272372	,220102	,178046	,144173	,116864	,077009
45	264439	,212659	,171198	,137964	,111297	,072650
46	,256737	,205468	,164614	,13202	,105997	,068538
4	249259	,198520	,158283	,126338	,100949	,064658
48	,241999	,191806	,152195	,120898	,096142	,060998
49	,234950	,185320	,146341	,115692	,091564	,057546
50	,228107	,179053	,140711	,110710	,087204	,054288
51	,221463	,172998	,135300	,105942	,083051	,051215
52	,215013	,167148	,130097	,101380	,079096	,048316
53	,298750	,161496	,125093	,097014	,075330	,045582
54	,202670	,156035	,120282	,092837	,071743	,043001
55	,196767	,150758	,115656	,088839	,068326	,040567
56	,191036	,145660	,111207	,085013	,065073	,038271
57	,185472	,140734	,106930	,081353	,061974	,036105
58	,180070	,135975	,102817	,077849	,059023	,034061
59	,174825	,131377	,098963	,074497	,056212	,032133
60	,169733	,126934	,095060	,071289	,053536	,030310
61	,164789	,122642	,091404	,068219	,050986	,028598
62	159990	,118495	,087889	,065281	,048558	,026989
63	,155330	,114487	,084508	,062470	,046246	,025453
64	150806	,110616	,081258	,059780	,044044	,024012
65	,146413	,106875	,078133	,057206	,041946	,022653
66	,142149	,103261	,075128	,054742	,039949	,021370
67	,138009	,099769	,072238	,052385	,038047	,020161
68	,133989	,096395	,069460	,050129	,036235	,019020
69	,1300 6	,093136	,066788	,047971	,034509	,017943
70	,126297	,019986	,064219	,045905	,032866	,016927

Continued in the following Page.

	3 per Ct.	3½ pr Ct.	4 per Ct.	4½ pr Ct.	5 per Ct.	6 per Ct.
71	,122619	,086943	,061749	,043928	,031301	,015969
72	,119047	,084003	,059374	,042037	,029811	,015065
73	,115580	,081162	,057091	,040226	,028391	,014212
74	,112214	,078418	,054895	,038496	,027039	,013408
75	,108945	,075766	,052784	,036834	,025752	,012649
76	,105772	,073204	,050754	,035250	,024525	,011933
77	,102691	,070728	,048801	,033732	,023357	,011258
78	,099700	,068336	,046924	,032280	,022245	,010620
79	,096796	,066026	,045120	,030890	,021186	,010019
80	,093977	,063793	,043384	,029559	,020177	,009452
81	,091240	,061636	,041716	,028287	,019216	,008917
82	,088582	,059551	,040111	,027068	,018301	,008412
83	,086002	,057538	,038569	,025903	,017430	,007936
84	,083497	,055592	,037085	,024787	,016600	,007487
85	,081065	,053712	,035659	,023720	,015809	,007063
86	,078704	,051896	,034287	,022699	,015056	,006663
87	,076412	,050141	,032968	,021721	,015339	,006286
88	,074186	,048445	,031700	,020786	,013657	,005930
89	,072027	,046807	,030481	,019891	,013006	,005595
90	,069928	,045224	,029309	,019034	,012387	,005278
91	,067891	,043695	,028182	,018215	,011797	,004979
92	,065914	,042217	,027098	,017430	,011235	,004697
93	,063994	,040789	,026055	,016680	,010700	,004432
94	,062130	,039410	,025053	,015961	,010191	,004181
95	,060320	,038077	,024090	,015274	,009705	,003944
96	,058563	,036790	,023163	,014616	,009243	,003721
97	,056858	,035546	,022272	,013987	,008804	,003510
98	,055202	,034344	,021416	,013385	,008384	,003312
99	,053594	,033182	,020592	,012808	,007985	,003124
100	,052033	,032060	,019800	,012257	,007604	,002057

End of the Table.

TA-

TABLES of EQUALITY, commonly called the PENCE TABLES.

d.		s.	d.	s.		d.
20	=	1	8	2	=	24
30	=	2	6	3	=	36
40	=	3	4	4	=	48
50	=	4	2	5	=	60
60	=	5	0	6	=	72
70	=	5	10	7	=	84
80	=	6	8	8	=	96
90	=	7	6	9	=	108
100	=	8	4	10	=	120
110	=	9	2	11	=	132
120	=	10	0	12	=	144

TABLE of RATIOS.

Rate £	Ratio Sim: Int: £	Ratio Com: Int: £
$\frac{1}{8}$	,00125	1,00125
$\frac{1}{4}$	,0025	1,0025
$\frac{3}{8}$	,00375	1,00375
$\frac{1}{2}$	,005	1,005
$\frac{5}{8}$	,00625	1,00625
$\frac{3}{4}$	,0075	1,0075
$\frac{7}{8}$	,00875	1,00875
1	,01	1,01
2	,02	1,02
3	,03	1,03
4	,04	1,04
5	,05	1,05
6	,06	1,06
7	,07	1,07
8	,08	1,08
9	,09	1,09
10	,1	1,1

TARE,

TARE, is an Allowance made to the Buyer for the Weight of the Bag, Box, Chest, Wrapper, or whatever else the Goods bought are contained in.

TARE and TRETT, is a Rule used by Merchants in estimating the neat Weight of any Commodity.

CASE I.

When the Tare is at so much in the Whole.

RULE. Subtract it from the Gross Weight, and the Remainder will be the Neat Weight.

EXAMPLE.

		Cwt.	Qr.	lb
In four Bales of Silk Gross		5	0	12
Tare in the Whole — —		0	3	16
How much Net Weight?	Ans.	4	0	24

CASE II.

When the Tare is at so much per Hhd. Chest, Bag, &c.

RULE. Multiply the Tare by the Number of Hhds. Chests, Bags, &c. and subtract the Product from the whole Gross Weight: The Remainder will be the neat Weight.

EX-

EXAMPLE.

Bought five Chests of Tea, Groſs, 4Cwt. 12lb. Tare per Cheſt 16lb. How much neat Weight?

	Cwt.	Qr.	lb			Qr.	lb
Groſs	4	0	12				16
Tare	–	2	24				5
Neat	3	1	16	Anſr.		2	24

CASE III.

When the Tare is at ſo much per Cwt.

RULE. Divide the whole Groſs Weight by ſuch aliquot Parts of an Cwt. as are equal to the given Tare: The Sum of the Quotients will be the whole Tare; which ſubtract from the Groſs, and the Remainder will be the neat Weight.

EXAMPLE.

In four Hhds. of Sugar, each 9Cwt. 3Q. 10lb Groſs. Tare, per Cwt. 18lb, how much neat Weight?

Groſs

		Cwt.	Q.	lb		
		9	3	10		
				4		
lb						
16	1/7	39	1	12		Gross
2	1/8	5	2	13	11	
		0	2	22	11	
		6	1	8	6	Tare
Answer		33	0	3	10	Net Wt.

CASE IV.

When Trett is is allowed with the Tare.

RULE. Divide the Pounds Suttle by 26, and Subtract the Quotient from the said Pounds Suttle: The Remainder will be the Pounds neat?

EXAMPLE.

In one Butt of Currants, weighing 12 Cwt. 2 Qrs. 24lb. Gross, Tare 14lb. *per Cwt.* Trett, 4lb. *per* 164lb. how many Pounds neat?

N n Cwt.

	Cwt. Qr. ℔.
	12 .. 2 .. 24
	4
	50
	28
14 = $\frac{1}{8}$	1424 Grofs.
	178 Tare.
26)	1246 Suttle.
	47 Trett.
	Anfwer 1199 ℔ neat

CASE V.

When Cloff is allowed.

Rule. Multiply the Cwts. Suttle by 2, and divide the Product by 3; the Quotient will be the Pounds Cloff, which fubtract from the Suttle; and the Remainder will be the neat Weight.

EXAMPLE.

What is the neat Weight of 3 Hogfheads of Tobacco, weighing 15 Cwt. 3 Qrs. 20 ℔. Grofs, Tare 7 ℔. *per Cwt.* Trett 4 ℔. *per* 104. Cloff 2 ℔. for 3 Cwt.

Anfwer

Anſ. 14 Cwt. 1 Qr. 3 ℔.

	Cwt.	Qr.	℔.	
$7 = \frac{1}{16}$	15	3	20	Groſs.
		3	$27\frac{1}{2}$	Tare.
$\frac{1}{26}$	14	3	$20\frac{1}{2}$	Suttle.
		2	8	Trett.
	14	1	$12\frac{1}{2}$	Suttle.
			$9\frac{1}{2}$	Cloff.
	14	1	3	Neat.

THEORETICAL ARITHMETIC, is that which ſhews the Nature and Property of Numbers, and Demonſtrates the Reaſon of a practical Operation.

TIME, a Succeſſion of the Senſes or Ideas. That intermediate Space, or Interval, between the happening of any two Events which are not immediately coincident with each other.

Lucretius, Lib. I. *Page* 16, Speaks thus;

" *Time of itſelf is nothing but from Thought,*
" *Receives its Riſe by labouring Fancy wrought;*
" *From Things conſider'd, whilſt we think on ſome,*
" *As preſent, ſome as paſt, or yet to come.*
" *No Thought can think on Time, that's ſtill confeſt,*
" *But thinks on Things in Motion or at reſt.*

The Time which the Sun requires to perform his Revolution through the 12 Signs of the Zodiac, being 365 Days, 5 Hours, 48

Minutes and 55 Seconds is called a Solar Year.

The Julian Year consists of 365 Days, 6 Hours, and is divided as in the following Table.

60 Seconds	make	1 Minute
60 Minutes		1 Hour
24 Hours		1 Day
7 Days		1 Week
13 Months, 1 Day, 6 Hours		1 Julian Year.

N. B. By the Callender the Year is divided into 12 Months; namely, *January*, *February*, *March*, *April*, *May*, *June*, *July*, *August*, *September*, *October*, *November*, *December*.

☞ *Thirty Days hath* September,
April, June *and* November,
February *hath twenty-eight alone*,
All the rest have thirty-one;
Except in Leap-Year, and then's the Time,
February's *Days are twenty and nine.*

TRETT, is an Allowance of 4℔ in every 104℔ on some Sort of Goods in Consideration of Waste, Dust, &c.

TRIPARTIENT NUMBER, is such as will divide another into three equal Parts, without leaving a Remainder.

TRIPLICATE RATIO, is that of the Cubes of any two Numbers.

TROY WEIGHT, is that which is used in weighing

weighing Gold, Silver, Jewels, and all Liquors. *See the Table.*

Grains	Pnywts.	Ounces	Pound
24	1	——	——
480	20	1	——
5760	240	12	1

The Moniers have alſo other Denominations of this Weight, *viz.*

24 Blanks	make	1 Perit
20 Perits	make	1 Droit
24 Droits	make	1 Mite
20 Mites	make	1 Grain

TRUCK, Exchange or Barter.

V

VALUATION of ANNUITIES upon LIVES, depends upon the Probability of the Lives continuing in Being one, two, three, or any other Number of Years. Hence the following Lemma becomes neceſſary.

LEMMA I.

The Probability that a Perſon of any given Age has of living one, two, three, &c. Years, or to any Age propoſed, is the Quotient ariſing from dividing the Number of the Living anſwering to the propoſed Age

Age (in any Table of Obſervations) by the Number of the Living anſwering to his given or preſent Age. And the Probability of his not living to the propoſed Age, is the Difference ariſing from ſubtracting the aforeſaid Quotient from an Unit, or one.

EXAMPLE.

Suppoſe a Perſon now aged 17 Years: *Query*, The Probability of his living 12 Years longer?

17 Preſent Age
12
—
29 Future ditto

515)422,0000(,8194 Anſwer
4120
—
1000
515
—
4850
4635
—
2150
2060
—

And the Probability of his not living the propoſed Time is

1—,8194=,1806.

PROB.

PROB. I.

To find the Value of an Annuity upon the Contingency of a Life of any proposed Age; that is, for as long as that Life shall exist. Interest being allowed at any Rate *per Cent.*

RULE. Multiply the present Worth of 1*l.* discounted at the given Rate for one Year, by the Probability of the Life proposed existing one Year. Also multiply the present Worth of 1*l.* discounted for two Years by the Probability of the Life's existing two Years; and in this Manner proceed with the third, fourth, fifth, &c. Years, until the Extremity of old Age, the Sum of the several Products multiplied by the Annuity, will be the Value required.

EXAMPLE.

What is present Value of 50*l.* Annuity to continue during the Life of a Person now aged 84 Years: Interest being allowed at 4*l. per Cent?*

£			£
,9615	× 11	=	10,5765
,9245	× 9	=	8,3205
,8890	× 7	=	6,2230
,8548	× 5	=	4,2740
,8219	× 4	=	3,2876
,7903	× 3	=	2,3709

13)35,1525(2,704
26 50
91 £135,200 = 135 4 Anſ. (£ s.)
91
52
52

As the Probability of living any propoſed Time is properly expreſſed by a vulgar Fraction whoſe Numerator is the Number of the Living anſwering to the propoſed Age, and its Denominator the Number of the Living anſwering to the preſent Age; and conſequently Common. You need only multiply the preſent Worths by the Numerator, of the reſpective Probabilities, and divide the Sum of the Products by the common Denominator.

N. B. As the foregoing general Rule is ſomewhat tedious, and not altogether practicable when a Table of Obſervations is not at hand, I ſhall inſert the following Caſes as independant of any Table whatever.

CASE

CASE I.

When the present Age of the proposed Life is upwards of 44 Years.

RULE. Reserve the Difference between the given Age and 92 Years; also multiply the said Difference by the Ratio *(Simp: Int:)* and to the Product add 2.47. Divide the Difference reserved by that Sum; The Quotient multiplied by the Annuity will be Value required.

EXAMPLE.

What is the present Worth of 40*l.* Annuity upon the Contingency of a Life now aged 72 Years. Interest being allowed at 4*l. per Cent?*

Oo. 92

```
  92
  72
  --
  20*
  ,04
  --
  ,80
 2,47
 ----
3,27 ) 20,00 ( 6,1162
       1962       40
       ----  -------          £. s. d.
        380  £244,648 = 244 12 11½ An.
        327  ========
        ---
         530
         327
         ---
         2030
         1962
         ----
          680
          654
          ===
```

CASE II.

When the present Age of the proposed Life exceeds 11 Years, but is not greater than 44 Years.

RULE. Reserve the Difference between the given Age and 29 Years, and also between the same Age and 100 Years; multiply the former of those Differences by ten Times the Ratio *(Simp: Int:)* and add or subtract

tract the Product to or from the second Difference,* multiply the Result by 40, and reserve the Product. Then to the given Age add an 100 Years, and multiply the Sum by 22 Times the Ratio (*Simp: Int:*) Add 100 to the Product, and by this Sum divide the Product reserved; The Quotient multiplied by the Annuity will be the present Worth required.

EXAMPLE.

What is the present Worth of 20*l.* Annuity upon the Contingency of a Life now aged 25 Years; Interest being allowed at the Rate of 4*l.* *per Cent*?

* *If the given Age exceeds* 29 *Years, add,* But if on the Contrary, subtract.

```
  29          ,04          100
  25           10           25
 ___         _____        _____
  4*          ,40           75
                4*           1,6§
             _____        _____
             1,60§         73,4
             =====            40
                          _______
                          2936,0||
                          =======
   25
  100          ,04
 _____          22
  125          ___
  ,88†         ,88†
 _____          ==
 1000
1000
______
110,00
100
_____
210)2936||(13,98
     210       20
    _____  ________
      836  £279,60 = £. 279  s. 12 Anf.
      630  ========
     _____
     2060
     1890
     _____
      1700
      1680
      ====
```

N. B. The foregoing Cases are particularly adapted to *London* Lives.

CASE

CASE III.

When the present Age of the given Life is any Number of Years under 86.

RULE I. Find the present Worth of 1*l.* Annuity certain for the Time intercepted between the given Age and 86 Years, and multiply it by the Ratio *(Comp: Int:)* divide the Product by the said intercepted Time, and subtract the Quotient from an Unit or one; divide that Difference by the Ratio. *(Simp: Int:)* That Quotient, multiplied by the Annuity, will be the Value required.

EXAMPLE.

Let every Thing be the same as in Example of Case I.

86
72 = given Age.
14 = The intercepted Time

The present Worth of 1*l.* Annuity, certain for 14 Years, at 4*l.* *per Cent.* is 10,563*l.* *(Per Case I. Purch: Ann:)*

10,563

```
        10,563
         1,04
        ------
        42252
       10563
       --------
  14)10,98552(,78468
       98
       ---
       118
       112
       ---
         65
         56
        ---
         95        1,00000
         84         ,78468
        ---        -------
        112   ,04),21532
        112        -------
        ===         5,383
                       40
                  ------        £. s. d.
                  £215,32 = 215 6 4¾ Ans.
                  =======
```

Questions in this Case may be wrought by the following Rule; the Results being the very same as by the foregoing.

Rule II. Find the ptesent Worth of one Pound discounted at the proposed Rate for the Time intercepted between the given Age and 86 Years; and add it to the intercepted Time, made less by an Unit or one. Multiply

Multiply that Sum by the Ratio *(Comp: Int:)* and from the Product subtract the aforesaid intercepted Time; divide the Difference by the Square of the Ratio *(Simp: Int:)* multiplied by the intercepted Time; and the Quotient, multiplied by the Annuity, will be the Value required.

EXAMPLE.

Let every Thing here be supposed the same as in Example of Case II.

86
25 Given Age.
—
61 the intercepted

Present Worth 1*l.* discount 4*l.* *per Cent.* for 61 Years = ,0914*l.*

61 intercepted Time.
1

60,0000 ,04
,0914 ,04

60,0914 0016
1,04 61

2403656 16
600914 96

62,495056 ,0976
61,

,0976)1,495056(15,31
976 20

5190 £306,2 = 306 4 Anf.
4880

3105
2928

1776
976

This Cafe is adapted as a Mean between the *London* and the Country Lives, and is confequently the beft for general Ufe.

N. B. The Value of an Annuity for a Life of any given Age being once obtained, the prefent Value of the fame Annuity for a Life one

Year younger than the Life given may also easily be found by the following RULE.

To the present Worth of the Annuity for the given Life, add the Annuity; and multiply the the Sum by the present Worth of 1 £. discounted at the proposed Rate for 1 Year; and also multiply that Product by the Probability of the youngest Life living one Year; the last Product will be the Value required. ☞ This Case is applicable to Town or Country Lives.

LEMMA II.

The Probability of any Number of Persons (whose Ages are given) continuing in Being together one, two, three, *&c.* Years; or any Time proposed, is the Product arising from the Multiplication, into each other, of the Probabilities that the Persons each have of living during the proposed Term *(per Lemma* 1.) as independent of one another.— And the Probability of their not all continuing in Being together the proposed Term is the Difference arising from subtracting the aforesaid Product from an Unit, or One.

EXAMPLE.

Suppose two Persons, the One aged 40 and the Other 60; query the Probability of their joint Existence for a Term of 10 Years.

The Probability of the youngest living 10 Years longer is $\frac{224}{322}$ }
Ditto of the older is $\frac{76}{147}$ } *Per Lemma* I.

Their Product is $\frac{17024}{47334}$ the Probability required.

PROB. II.

To find the Value of an Annuity upon the Contingency of any Number of joint Lives; that is for as long as they all shall continue to exist together.

RULE. Multiply the present Worth of one Pound discounted for one Year at the given Rate, by the Probability of all the Lives existing together one Year. Also, multiply the present Worth of one Pound discounted for two Years, by the Probability of the given Lives existing together two Years; and in this Manner proceed with the third, fourth, fifth, *&c.* Years, until the Probability of their existing together becomes 0, or nothing; that is, till some one of the Lives fail. The Sum of all the Products multiplied by the Annuity, will be the Value required.

EXAMPLE.

What is the present Value of 50 *£.* Annuity upon the Contingency of two joint Lives whose present Ages are 12, and 84 Years Interest being allowed at *4l. per Cent?*

£

£.		£.
,9615×11×541	=	5721,8865
,9245× 9×534	=	4443,1470
,8890× 7×528	=	3285,7440
,8548× 5×522	=	2231,0280
,8219× 4×515	=	1693,1140
,7903× 3×508	=	1204,4172

549×13=7137)18579,3367(2,6032
14274   50
43053   £130,1600
42822   Anſ.
23136
21411
17257
14274

The Objections to this Rule being the ſame with thoſe already made to the general Rule for calculating Annuities for ſingle Lives; an Apology therefore for introducing the following Caſes becomes needleſs.

CASE I

When the Number of Lives are two only.

RULE. Subtract the given Ages each from 86 Years, and reſerve the Differences: Then from the leaſt Difference reſerved, ſubtract an Unit, or one, and divide the Remainder by ſix Times the Ratio, (*Comp. Int:*)

Int:) ſubtract the Quotient from the preſent Value of 1 *l.* Annuity upon the Contingency of the Life of the oldeſt Perſon, and multiply the Remainder by the Sum of the leaſt Difference reſerved, added to an Unit or One. Divide the Product ſo found by double the greateſt Difference reſerved, and ſubtract the Quotient from the preſent Value abovementioned, that Remainder multiplied by the Annuity, will be the Value required.

CASE II.

When the Number of Lives are three only.

RULE. Subtract the given Ages each from 86 Years, and reſerve the Differences.

Then to the leaſt Difference add an Unit or One, and divide the Sum by double the next greater Difference. The Quotient I'll here note by *X*. Alſo divide the ſame Sum by double the greateſt Difference.—That Quotient I'll here Note by *Z*. Subtract each of theſe Quotients from an Unit or One, and multiply the Remainders together, and their Product by the Value of 1*l.* Annuity upon the Contingency of the oldeſt Life. This laſt Product I'll here note by *M*.

To the leaſt of the Differences reſerved, add the Number 3, and ſubtract the Total from the doubled Sum of the two greater of the ſaid Differences; multiply the Remainder by the Quotient noted *X*, and reſerve

the Product; from the least Difference reserved subtract an Unit or one, and divide the Remainder by six Times the Ratio; *(Comp: Int:)* multiply the Quotient by the Product reserved, and divide the Result by double the greatest Difference reserved, and to the Quotient hence arising add the Product noted *M*: That Sum, multiplied by the Annuity, will be the Value required.

PROB. III.

To find the Value of an Annuity upon the Contingency of any Number of Lives; that is, to continue as long as any of them are existing.

RULE. The Sum of the Values of all the single Lives, *less* the Sum of the Values of all the joint Lives that can be combined together by two and two; *more* the Sum of the Values of all the joint Lives that can be combined together by three and three; *less* the Sum of the Values of all the joint Lives that can be combined together by four and four; and so on alternately *more* and *less* the Sums of the Values of all the joint Lives arising from the several Combinations* of the given Lives, until the last Combination consists of all the given Lives taken together; will be the Value required.

N. B. The present Value of an Annuity is always

* Taking one Life more in each succeeding Combination than there was in that of its next preceding.

always ¼ of a Year's Purchase more when the Payments are Half-yearly, and ⅜ of a Year's Purchase more when Quarterly, than it is when the Payments are made Annually.

VALUATION of ANNUITIES upon successive LIVES.

PROB. I.

Suppose a Person of a given Age is to enjoy an Annuity for his Life, and at his Decease to have the Nomination of a Successor of any Age, who is likewise to enjoy the Annuity for his Life: To find the present Value of that Succession.

RULE. Multiply the Values of the two single Lives into each other, and divide the Product by the Perpetuity; * subtract the Quotient from the Sum of the Values of the two single Lives, and the Difference will be the Value required.

PROB. II.

Three Lives in Succession being given to find their present Value.

RULE. Multiply the Value of each of the given Lives by the Ratio *(Simp: Int:)* and subtract the Products severally from an Unit or one. Multiply the Differences all together, and subtract the Result from an Unit

* The Value of the Annuity for ever.

Unit or one. Multiply the Remainder by the Perpetuity, and that Product will be the Value required.

PROB. III.

A Person proposes to advance a certain Sum in the Purchase of a certain Estate Copyhold, upon any Number of Lives; provided that he and his Heirs for ever, upon the Extinction of any Life, may, upon the Payment of an equivalent Fine, have the Liberty of renewing with any other Life, as they shall think proper: To find what that Fine ought to be.

RULE. From the Perpetuity subtract the Sum paid upon first entering, and multiply the Difference by the Value of the Life with which the Lease is to be constantly renewed; reserve the Product. Subtract the Sum of the Values of all the single Lives upon which the Lease is first granted, from the Rectangle of the Perpetuity into the Number of the said Lives, and by that Difference divide the Product reserved: The Quotient will be the Fine required.

PROB. IV.

A Person in the Purchase of a certain Estate, Copyhold, upon any Number of Lives, proposes, that he and his Heirs for ever will pay a certain Fine for renewing, provided it may be with any Life they shall think proper; and also to make the Purchase equitable

quitable would advance a Sum at his first entering: To find what that Sum ought to be.

RULE. Subtract the Sum of the Values of all the single Lives upon which the Lease is first granted, from the Rectangle of the Perpetuity into the Number of the said Lives, and divide the Difference by the Value of the Life with which the Lease is to be constantly renewed; multiply the Quotient by the Sum to be paid at each renewal, and subtract the Product from the Perpetuity: That Difference will be the Sum required.

VALUATION of ANNUITIES upon the Contingency of REVERSIONARY LIVES, may be universally performed by the following general RULE; respect being had to the Condition of their Connection.

From the Value of all the Lives taken together, subtract the Value of the Lives in Possession, the Remainder will be the Value of the Reversion.

UNIT, one. The first Principle of Number, an Integer.

USANCE, (in Exchange) the intermediate Time from any Day of one Month to the same Day of the next Month.

WINE MEASURE, is that which is used in measuring Wines, Brandies, Spirits, Cyder, Mead, Vinegar, Honey, and Oil. Milk is also sold by this Standard, not by Law but by Custom, only Note,

Cubic

Cubic Inches.	Pints	Qts.	Gall.	Tier.	Hhd.	Pun-chn.	pipe	tun
$28\frac{7}{8}$	1	—	—	—	—	—	—	—
$57\frac{3}{4}$	2	1	—	—	—	—	—	—
231	8	4	1	—	—	—	—	—
9702	336	168	42	1	—	—	—	—
14553	504	252	63	$1\frac{1}{2}$	1	—	—	—
19404	672	336	84	2	$1\frac{1}{3}$	1	—	—
29106	1008	504	126	3	2	$1\frac{1}{2}$	1	—
58212	2106	1008	252	6	4	3	2	1

According to the true Standard, the Wine Gallon contains only 224 Gubic Inches, as appears from an Experiment made at *Guild-hall*, *London*, *May* the 25th 1688.

WOOL WEIGHT, is that which is uſed by Wool-Staplers and all ſuch Perſons as deal in that Commodity.

See the T A B L E.

7 Pounds*	make	1 Clove
2 Cloves	make	1 Stone
2 Stones	make	1 Todd
6 Todds & 1 Stone	make	1 Wey
2 Weys	make	1 Sack
12 Sacks	make	1 Laſt

* Avoirdupoiſe.

The End of the DICTIONARY.

A Collection of Questions.

1 HOW many Guineas will purchase 147 Ells Flem: at the Rate of 20 Marks for 15 Yards? *Ans.* 97 Gui. 3 s.

2. A Person bought 120 Yards of Cloth at a certain Price, and sold it again for 100 Moidores, his Gain upon the Whole was after the Rate of 15 *l. per Cent.* Query, what the Cloth cost him per Ell *Eng:* *Ans.* 1 *l.* 3 *s.* 10 *d.* $\frac{3}{4}$,5.

3. In 69426 Marks how many Dollars of 4 s. 7 *d.* $\frac{1}{2}$ each, Crowns and Guineas; supposing the Number of Crowns and Dollars to be equal, and the Number of Guineas to be equal to the Number of Crowns and Dollars taken together? *Ans.* 17930 Crs: 17930 Dols: 35870 Guis:

4. In 4 Hogsheads of Sugar gross Weight as follows, *viz.* N° 1 – 6 *Cwt.* 3 *qrs.* 27 ℔. N° 2 – 10 *Cwt.* 6 ℔. N° 3 – 8 *Cwt.* 1 *qr.* 17 ℔. N° 4 – 11 *Cwt.* 13 ℔. Tare *per Hhd.* 1 *qr.* 10 ℔ $\frac{1}{2}$ Tret, 4 ℔ *per* 104 ℔. How many Ounces neat Weight, and what do they amount to at 2 *l.* 14 *s. per Cwt.* *Ans.* 60640 *Oz.* 91 *l.* 7 *s.* 3 *d.* $\frac{3}{4}$ $\frac{48}{112}$ *Ans.*

5. In 481 *Tun,* 17 *Cwt.* 3 *qrs.* 23 ℔. how many Drams? *Ans.* 130158336.

6. If 285 Ells Flem. cost 200 *l.* what is the Value of $\frac{2}{3}$ of that Number of Yards at the same Rate? *Ans.* 177 *l.* 15 *s.* 6 *d* $\frac{3}{4}$ $\frac{75}{855}$

7. A Merchant bought 3 Pipes of Canary at 27 *l. per* Pipe, and sold $\frac{1}{4}$ of it again at 5 *s.* 3 *d. per* Gallon, how must he sell the Remainder *per* Gallon, so as to gain 30 *l.* by the Whole? *Ans.* 9 *s.* 4 *d.* $\frac{1}{2}$ $\frac{342}{387}$

8. Four Men traded with a Stock of 800 *l.* and they gained in two Years Time twice as much

and 40 *l.* over: *A*'s Stock was 140 *l.* *B*'s 260 *l.* *C*'s 300 *l.* I demand *D*'s Stock, and what each Man gain'd by Trading? *Anſw.* *D*'s Stock was 100 *l.* and *A* gain'd 287 *l.* *B* 533 *l.* *C* 615 *l.* and *D* 205 *l.*

9. *A*, *B*, and *C*, hold a Paſture in common, for which they pay 20 *l.* *per Annum.* In this Paſture *A* had 40 Oxen for 76 Days; *B* had 30 Oxen for 50 Days; and *C* had 50 Oxen for 90 Days. I demand what Part every of theſe Tenants ought to pay of the 20 *l.*

		l.	*s.*	*d.*	*qrs.*
Anſw.	*A ought to pay*	6	10	2	$\frac{1}{4}\ \frac{2340}{9340}$
	B - - - - - - - -	3	17	1	$0\ \frac{2000}{9340}$
	C - - - - - - - -	9	12	8	$\frac{1}{2}\ \frac{5000}{9340}$

10. My Correſpondent in *Rotterdam* ſends me Word, that he has diſburſed upon my Account, the Sum of 3060 Guilders and 15 Stivers; what Sum muſt I anſwer for that at *London*? the Courſe being at 37 *s.* 9 *d.* Flemiſh *per l.* Sterling?—— *Anſw.* 270 *l.* 5 *s.* 3 *d* $\frac{1}{4}$ $\frac{188}{453}$

11. Suppoſe I receive 754 *l.* 1 *s*, 8 *d.* now, for a Sum of Money due 11 Months hence, allowing 6 *per Cent.* for preſent Payment; I demand the Sum that was due at firſt? *Anſ.* 795 *l.* 7 *s.* 2 *d.*

12. What Principal being put to Intereſt for 189 Days at 4 *per Cent.* will amount to 200 *l.* 1 *s.* 2 *d.* $\frac{1}{2}$? *Anſw.* 196 *l.*

13. If 70 *l.* Annuity payable every half Year, were unpaid 5 Years; what would it amount to in that Time at 5 *per Cent.*? *Anſw.* 389 *l.* 7 *s.* 6 *d.*

14. A Gentleman in his Will leaves 50 *l.* to the Poor, and ordered that $\frac{1}{3}$ ſhould be given to antient Men, each to have 5 *s.*—$\frac{1}{4}$ to poor Women,

men, each to have 2 *s.* 6 *d.*—$\frac{1}{3}$ to poor Boys, each to have 1 *s.*—$\frac{1}{6}$ to poor Girls, each to have 9 *d.* and the Remainder to the Person that distributed it. I demand how many of each Sort there were, and what the Person that distributed the Money had for his Pains.? *Anf.* 66 *Men,* 100 *Women,* 200 *Boys,* 222 *Girls.* 2 *l.* 13 *s.* 6 *d.* to the Person.

15. There are three Numbers, 17, 19 and 48; I demand the Difference between the Sum of the Squares of the first and last, and the Cube of the Middlemost? *Answ.* 4266.

16. In 7 Cheeses each weighing 1 *Cwt.* 2 *qrs.* 5 *lb.* how many Allowances for Seamen may be cut, each weighing 5 *oz.* 7 *dr.*? *Answ.* 3563$\frac{35}{87}$ Allowances.

17. In 81034 Rundlets of Brandy, each 18 Gallons, how many Gross of Bottles, each $\frac{5}{9}$ of a Quart? *Answ.* 45581 Gross, 7 Doz. 6 Bottles.

18. In 731 doz. bottles of Wine, each 1 $\frac{5}{7}$ Pint, how many Hhds? *Answ.* 29 hhds. 52 gallons, 5 pts. $\frac{5}{7}$

19. Sold 8 *C.* $\frac{1}{2}$ of Steel, at 12 *d. per lb.* how much *Flemish* Money at 33 *s. per* Pound Sterling, am I to receive for the same? *Answ.* 80 *l.* 2 *s.* 6 *d.* $\frac{96}{240}$

20. If 48 taken from 120 leave 72, and 72 taken from 91 leave 19, and 7 taken from thence leave 12; what Number is that, of which, when you have taken 48, 72, 19 and 7, leaves 12?—*Answ.* 158.

21. A Gentleman having 50 *s.* to pay among his Labourers for a Day's Work, would give to every Boy 6 *d.* to every Woman 8 *d.* and to every Man 16 *d.* the Number of Boys, Women

and Men, was the same; I demand the Number of each? *Answ.* 20 of each sort.

22. A Gentleman had 7 *l.* 17 *s.* 6 *d.* to pay among his Labourers; to every Boy he gave 6*d.* to every Women 8 *d.* and to every Man 16 *d.* and there were for every Boy three Women, and for every Woman two Men; I demand the Number of each? *Answ.* 15 Boys, 45 Women, 90 Men.

23. A Captain and 160 Sailors took a Prize worth 1360 *l.* of which the Captain had $\frac{1}{5}$ for his Share, and the rest was equally divided among the Sailors, what was each Man's Part? *Answ.* The Captain had 272 *l.* and each Sailor 6 *l.* 16 *s.*

24. What Number is that, to which if you add 7 $\frac{2}{3}$, the Whole will be 12 $\frac{1}{4}$? *Answ.* 4$\frac{7}{12}$

25. A Usurer put out 75*l.* for 12 Months, and received for Principal and Interest 81 *l.* I demand at what Rate *per Cent.* he received Interest?— *Answ.* 8 *l. per Cent.*

26. If a Man earn 2 *s.* 6 *d.* 2 *qrs. per* Day, how much is that for 19 Weeks, *Sundays* excepted? *Answ.* 14 *l.* 19 *s.* 9 *d.*

27. *A*, *B* and *C* traded together, the first laid in I know not how much; *B* put in 20 Pieces of Cloth; and *C* put in 500 *l.* and they have gained 1000 *l.* whereof *A* ought to have had 350 *l.* and *B* 400 *l.* I demand *C*'s Share, how much the first Man laid in, and what the 20 Pieces of Cloth were worth? *Answ.* *C*'s Share was worth 250 *l.* *A* laid in 700 *l.* and *B*'s Cloth was worth 800 *l.*

28 A Merchant buys up six Bags of *Canterbury* Hops, N° 1 of which weighed *Cwt.* 3 3 20. N° 2 *Cwt.* 3 2 26. N° 3 *Cwt.* 3 0 24. N° 4. Cwt.

ons

4, *Cwt.* 3 3 only; Nº 5, *Cwt.* 2 2 22. Nº 6, *Cwt.* 2 2 26, besides 5 Pockets, 3 of which weighed 76 *lb.* $\frac{3}{4}$ each, and the other two 62 *lb.* $\frac{1}{4}$ each; how many *Cwt.* has he to pay Carriage for? *Ans. Cwt.* 23 0 24$\frac{3}{4}$

29 How many Ducats must I deliver at *Venice*, to receive at *London* 178 *l.* 2 *s.* the Exchange being at 4 *s.* 4 *d. per* Ducat? *Ans.* 822 Ducats.

30 A Traveller would change 500 *French* Crowns at 4 *s.* 6 *d. per* Crown, into Sterling Money, but he must pay a Half-penny *per* Crown for Change; how much must he receive? *Answ.* 111 *l.* 9 *s.* 2 *d.*

31 When a Factor taketh 1 *l. per Cent.* for his Commission, what must he have for 743 *l.* 17 *s.* 3 *d.*? *Ans.* 7 *l.* 8 *s.* 9 *d.* 1 *qr.* $\frac{192}{2400}$

32 Two Merchants in Company gained 100*l.* *A* laid in so much that for his Share of the Gain he must have 60 *l.* *B* laid in 720 Ducats at 6 *s.* 8 *d. per* Ducat; I demand how much *A* laid in, and what the Ducats were worth? *Ans.* *A* laid in 360 *l.* and the Ducats were worth 240 *l.*

33 A Person dying, left his Widow 1780*l.* and 1250*l.* to each of his 4 Children; he had been 25$\frac{1}{2}$ Years in Trade, and had cleared, at an Average, 126*l.* a Year; what had he to begin with? *Ans.* 3567*l.*

34 There is a Sum of 1000*l.* to be divided among 3 Men, in such Manner, that if *A* has 3*l.* *B* shall have 5*l.* and *C* 8*l.* how much must each Man have? *Ans.* *A* 187*l.* 10*s.* *B* 312*l.* 10*s.* and *C* 500*l.*

35 A Piece of Wainscot is 8 Feet, 6$\frac{1}{2}$ Inches long, and 2 Feet, 9$\frac{3}{4}$ Inches broad; what is the superficial Contents? *Ans.* 24 Feet, $\frac{3}{2}$ & $\frac{4}{6}$.

36 How many Changes may be rung on 6 Bells? *Anſ.* 720.

37 A Merchant at *Amſterdam* is indebted to another in *London*, in 642*l.* and would pay it in Spaniſh Gilders at 2*s.* per Piece; how many muſt the Engliſh Merchant receive? *Anſ.* 6420*l.*

38 If 360 Men be in Garriſon, and have Proviſion for 6 Months, but hearing of no Relief at the End of 5 Months, how many Men muſt depart, that the Proviſions may laſt ſo much longer? *Anſ.* 288.

39 The leſs of 2 Numbers is 187, their Difference is 34; the Square of the Product is required? *Anſ.* 1707920929.

40 A Man dies and leaves 120*l.* to be given to 3 Perſons? *A*, *B*, and *C*; to *A* a Share unknown, *B* twice as much *A*, and *C* as much as *A* and *B*; what is the Share of each? *Anſ.* *A* 20*l.* *B* 40*l.* and *C* 60.

41 What Number taken from the Square of 54 will leave 19 Times 46? *Anſ.* 2042.

42 A School-maſter being aſked how many Scholars he had, ſaid, if I had as many more, half as many, and 1 Quarter as many, I ſhould have 99, how many had he? *Anſ.* 36.

43 An ancient Lady being aſked how old ſhe was, to avoid a direct Anſwer, ſaid, I have 9 Children, and there are 3 Years between the Birth of each of them; the Eldeſt was born when I was 19 Years old, which is now exactly the Age of the Youngeſt; how old was the Lady? *Anſ.* 62 *Years old.*

44 What Number is that which being added to 168, makes the Sum to be 706? *Anſ.* 538.

45 From

45 From 100*l.* borrowed take 72 paid,
'Twas a Virgin that lent it, what's due to the Maid?
Anſ. 28*l.*

46 If when Wheat is 4*s.* per Buſhel, the 20 Penny Loaf weighs 18*l.* what muſt the ſaid 20 Penny Loaf weigh when Wheat is 6*s.* the Buſhel? *Anſ.* 12 ℔.

47 Whereas a Noble and a Mark juſt 15 Yards did buy,
How many Ells of the ſame Cloth for 50*l.* had I? *Anſ.* 600.

48 A Broker bought for his Principal in the Year 1720, 400l. Capital Stock in the South-Sea at 650*l.* per Cent. and ſold it again when it was worth but 130 per Cent. how much was loſt in the Whole? *Anſ.* 2080*l.*

49 What Number added to the 43d Part of 4429 will make the Sum 240? *Anſ.* 137.

50 What Number deducted from the 26th Part of 2262 will leave the 87th Part of the ſame? *Anſ.* 61.

51 A Gentleman went to Sea at 17 Years of Age, 8 Years after that he had a Son born, who lived 46 Years, and died before his Father; after whom the Father lived twice 20 Years, and then died alſo; what was the Age of the Father when he died? *Anſ.* 111 Years.

52 *C* hath Candles at 6*s.* per Dozen, ready Money, but in Barter will have 6*s.* 6*d.* per Doz. *D* hath Cotton at 9*d.* per ℔ ready Money; I demand what Price the Cotton muſt be at in Barter, alſo how much Cotton muſt be bartered for 100 Dozen of Candles? *Anſ.* The Cotton 9*d.*$\frac{3}{4}$ per ℔. and 7 *cwt.* 16 ℔ of Cotton muſt be given for 100 Dozen of Candles.

53 The Sum of 2 Numbers is 360, the less 114; what is their Difference, Product, and larger Quote? *Ans.* 132 Diff. 28044 Product, $2\frac{3}{19}$ Quote.

54 A Brigade of Horse consisting 384 Men is to be formed into a Square Body, having 32 Men in Front? how many Ranks will there be? *Ans.* 12.

55 If a Clerk's Salary be 73*l.* a Year, what is that per Day? *Ans.* 4*s.*

56 *B* hath an Estate of 53*l.* per Annum, and payeth 5*s.* 10*d.* to the Subsidy; what must *C* pay whose Estate is worth 100*l.* per Annum? *Ans.* 11*s.* $\frac{4}{53}$*d.*

57 If I buy 100 Yards of Ribband at 3 Yards for a Shilling, and 100 more at 2 Yards for a Shilling, and sell it again at the Rate of 5 Yards for 2*s.* whether do I get or lose, and how much? *Ans.* Lose 3*s.* 4*d.*

58 What is the Value of $\frac{5}{8}$ of 20*s.*? *Ans.* 12*s.* 6*d.*

59 What Number is that which if you take $\frac{3}{5}$ the Remainder will be $\frac{1}{8}$? *Ans.* $\frac{29}{40}$.

60 My Purse and Money, quoth *Dick*, are worth 12*s.* 8*d.* but the Money is worth 7 of the the Purse; pray what was the Sum therein? *Ans.* 11*s.* 1*d.*

61 What Number is that which maketh 9 to be the $\frac{2}{3}$ of it? *Ans.* $13\frac{1}{2}$.

62 A Maltster has several Sorts of Malt, one at 4*s.* 6*d.* another at 4*s.* and a third at 3*s.* 6*d.* a Bushel; to mix an equal Quantity of each; what must be the Price of a Bushel? *Ans.* 4s.

63 A Farmer is willing to make a Mixture

of Rye at 4*s.* a Bushel, Barley at 3*s.* and Oats at 2*s.* how much must he take of each to sell it at 2*s.* 6*d.* the Bushel? *Anſ.* 6 of Rye, 6 of Barley, aud 24 of Oats.

64 If $\frac{3}{8}$ of a Ship be worth 3740*l.* what is the Worth of the Whole? *Anſ.* 9973*l.* 6*s.* 8*d.*

65 A Person said he had 20 Children, and that it happened there was a Year and half between each of their Ages, his Eldest was born when he was 24 Years old, and the Age of the Youngest was 21; what was the Father's Age? *Anſ.* 73$\frac{1}{2}$ Years.

66 Bought a Cask of Wine for 62*l.* 8*s.* how many Gallons were in the same, when a Gallon was valued at 5*s.* 4*d.* *Anſ.* 234.

67 *B* owes *C* 296*l.* 17*s.* but he compounds 7*s.* 6*d.* in the Pound; what must *C* receive for his Debt? *Anſ.* 111*l.* 6*s.* 4$\frac{1}{2}$*d.*

68 How many Dozen of Stockings at 11 Groats per Pair, may I buy for 190*l.* 12*s*? *Anſ.* 86 Dozen, 7 Pair, $\frac{23}{44}$.

69 A Sheepfold was robbed 3 Nights successively; the first Night half the Sheep were stolen, and half a Sheep more; the second Night half of the Remainder were lost, and half a Sheep more; the last Night they took half that were left, and half a Sheep more; by which Time they were reduced to 20; how many were they at first? *Anſ.* 167.

70 The Spectator's Club of Fat People, tho' it consisted but of 15 Persons, is said to weigh no less than 3 tons, how much, at an Equality, was that *per* Man? *Anſ.* 4 *cwt.*

71 A merry young Fellow in a small Time

 got

got the better of $\frac{1}{5}$ of his Fortune; by Advice of his Friends, he gave 2200*l.* for an Exempt's Place in the Guards; his Profusion continued 'till he had no more than 880 Guineas left, which he found upon Computation was $\frac{3}{20}$ Part of his Money, after the Commission was bought; pray what was his Fortune at first? *Anſ.* 10450*l.*

72 *B* owes *C* 395*l.* 18*s*, but compounds the the Whole Debt for 100*l.* 12*s.* what is that in the Pound? *Anſ.* 5*s.* 0*d.* $\frac{1}{2}$ $\frac{27746}{79518}$.

73 How many Dollars at 4*s.* 4*d.* each must be given for 360 Gilders at 2*s.* 2*d.* each? *Anſ.* 180.

74 Four Men have a Sum of Money to be divided amongſt them in ſuch a Manner, that the firſt ſhall have $\frac{1}{3}$ of it, the ſecond $\frac{1}{4}$, the third $\frac{1}{6}$, and the fourth the Remainder, which is 28; what was the Sum? *Anſ.* 112*l.*

75 What is the Amount of 1000*l.* for $5\frac{1}{2}$ Yrs. at $4\frac{3}{4}$ per Cent. ſimple Intereſt? *Anſ.* 1261*l.* 5*s.*

76 Sold Goods amounting to the Value of 700*l.* for 2 four Months; what is the preſent Worth, at 5 per Cent. ſimple Intereſt? *Anſ.* 682*l.* 19*s.* $5\frac{1}{2}$*d.*

77 A Room is 30 Feet long and 18 Feet wide, is to be covered with painted Cloth; how many Yards of $\frac{3}{4}$ wide will cover it? *Anſ.* 80 Yards.

78 There are 2 Numbers, the one 48, the other twice as much? what is the Difference between their Sum and Difference? *Anſ.* 96.

79 *Hetty* told her Brother *George*, that tho' her Fortune on her Marriage took 1931*l.* out of her Family, it was but $\frac{1}{4}$ of two Years Rent, (Heaven be praiſed!) of his yearly Income; pray what was that? *Anſ.* 16093*l.* 6*s.* 8*d.* a Year.

80 There

80 There are two Numbers, the one 25, the other the Square of 25; I demand the Square Root of the Sum of their Squares? *Answer* 625,4998.

81 Says *B* to *C*, If I had 4 of your Sheep, I should have as many as you; and says *C* to *B*, If I had 4 of yours. I should have twice as many as you? how many had each? *Ans.* *B* 20, *C* 28.

82 *B*, *C*, and *D*, trading together, gained 120*l.* which is to be shared according to each Man's Stock; *B* put in 140*l.* *C* 300, and *D* 160, what was each Man's Share; *Ans.* *B* 28*l.* *C* 60, and *D* 32.

83 A Stone that measures 4 Feet, 6 Inches long, 2 Feet, 9 Inches broad, and 3 Feet, 4 Inches deep? how many solid Feet doth it contain? *Ans.* 41 Feet, 3 Inches.

84 What does the whole Pay of a Man of War's Crew of 640 Sailors amount to for 32 Months Service, each Man's Pay being 22*s.* 6*d.* per Month? *Ans.* 23040*l.*

85 If I have an Estate of 470*l.* per Annum, what may I expend daily, and yet lay up 130*l.* per Annum? *Ans.* 18*s.* 7*d.* $\frac{1}{2}$ $\frac{98}{365}$.

86 What Number is that, which being divided by 19, the Quotient will be 72? *Ans.* 1368.

87 Reduce $13\frac{1}{2}$ Bushels of Coals to the Fraction of a Chaldron. *Facit* $\frac{3}{8}$.

88 Bought 28 Quarters, 2 Bushels of Wheat, at 4*s.* 6*d.* per Bushel; what does it come to? *Ans.* 50*l.* 17*s.*

89 How many Pounds of Coffee, at 5*s.* 9*d.* per lb. is equal in Value to 426 lb of Tea, at 13*s.* 4*d.* per lb? *Ans.* 987$\frac{57}{69}$.

90 What

90 What is the Value of 27 Dozen, 10 lb of Candles, at 5*d.* per lb? *Anſ.* 6*l.* 19*s.* 2*d.*

91 There are 2 Numbers, the one 63, the other ½ as much; I demand the Product of their Squares, and the Difference of their Product and Sum? *Anſ.* Product of their Squares 3938240,5, Difference 1890.

92 *B* and *C* traded together and gained 100*l.* *B* put in 640*l.* *C* put in ſo much that he muſt receive 60*l.* of the Gain: I demand how much *B* put in? *Anſ.* 960*l.*

93 Bought a Ton of Wine for 78*l.* 17*s.* at what Price muſt I ſell it per Quart to gain 5*l.* 10*s.* by the Whole? when there were 22 Gallons leaked out? *Anſwer* 22*d.* +

94 If out of 10*s.* per Week, I lay up 4*d.* 2 *qrs.* per Day, *Sundays* excepted; and have ſaved 9*l.* 2*s.* 3*d.* how long was I in laying it up, and how much have I ſpent in that Time?

Anſwer { 567 Days in laying up,
31*l.* 7*s.* 9*d.* ſpent.

95 If I buy 1000 Ells Flemiſh of Linen for 90*l.* what may I ſell it per Ell in *London* to gain 10*l.* by the Whole? *Anſwer* 3*s.* 4*d.* per Ell.

96 Bought threeſcore Pieces of Holland for 3 Times as many Pounds, and ſold them again for 4 Times as much; but if they had coſt me as much as I ſold them for, what ſhould I have ſold them for to gain after the ſame Rate? *Anſ.* 320*l.*

97 There are 3 Quantities of Silver, each of the ſame Weight, but different in Value; the Weight of each Quantity is 10 *oz.* the Value of the firſt Sort is 4*s.* per *oz.* of the ſecond 4*s.* 6*d.*

per

per *oz* and of the third 5*s*. per *oz*. I demand the Worth of an *oz*. when they are all melted down together? *Answer* 4*s*. 6*d*. per *oz*.

98 I have received Advice from my Factor, that he has disbursed upon my Account, the Sum of 4000 Gilders, 15 Stivers; I demand what Sum I must answer for that in English Money, Exchange at Par; and also what his Commission comes to at 2 per *Cent*.

Answer { 400*l*. 1*s*. 6*d*. Sterling.
8*l*. ¼*d*. Commission.

FINIS.

MVSEVM
BRITAN
NICVM